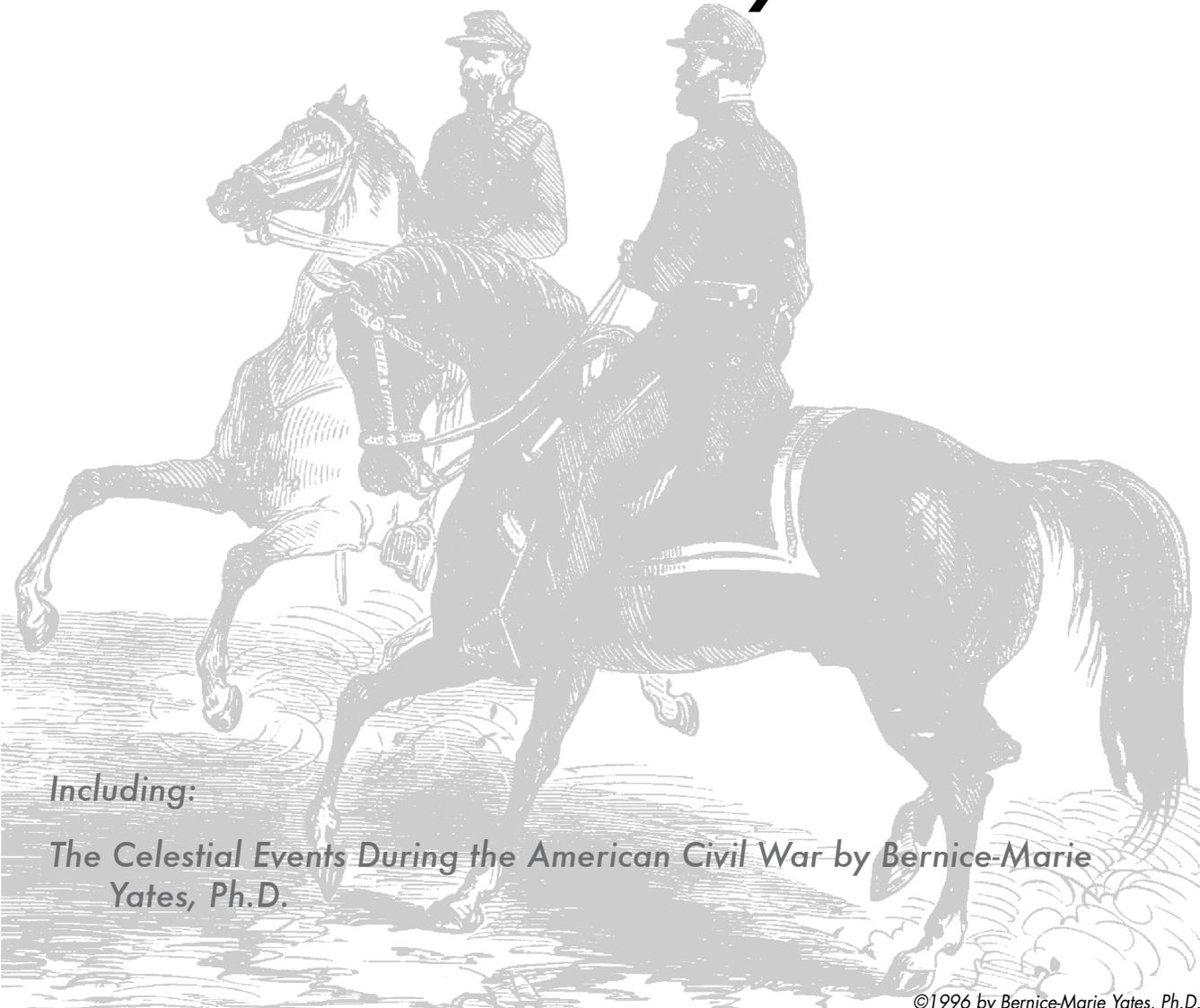


A Collection of Curricula for the STARLAB Civil War Skies Cylinder

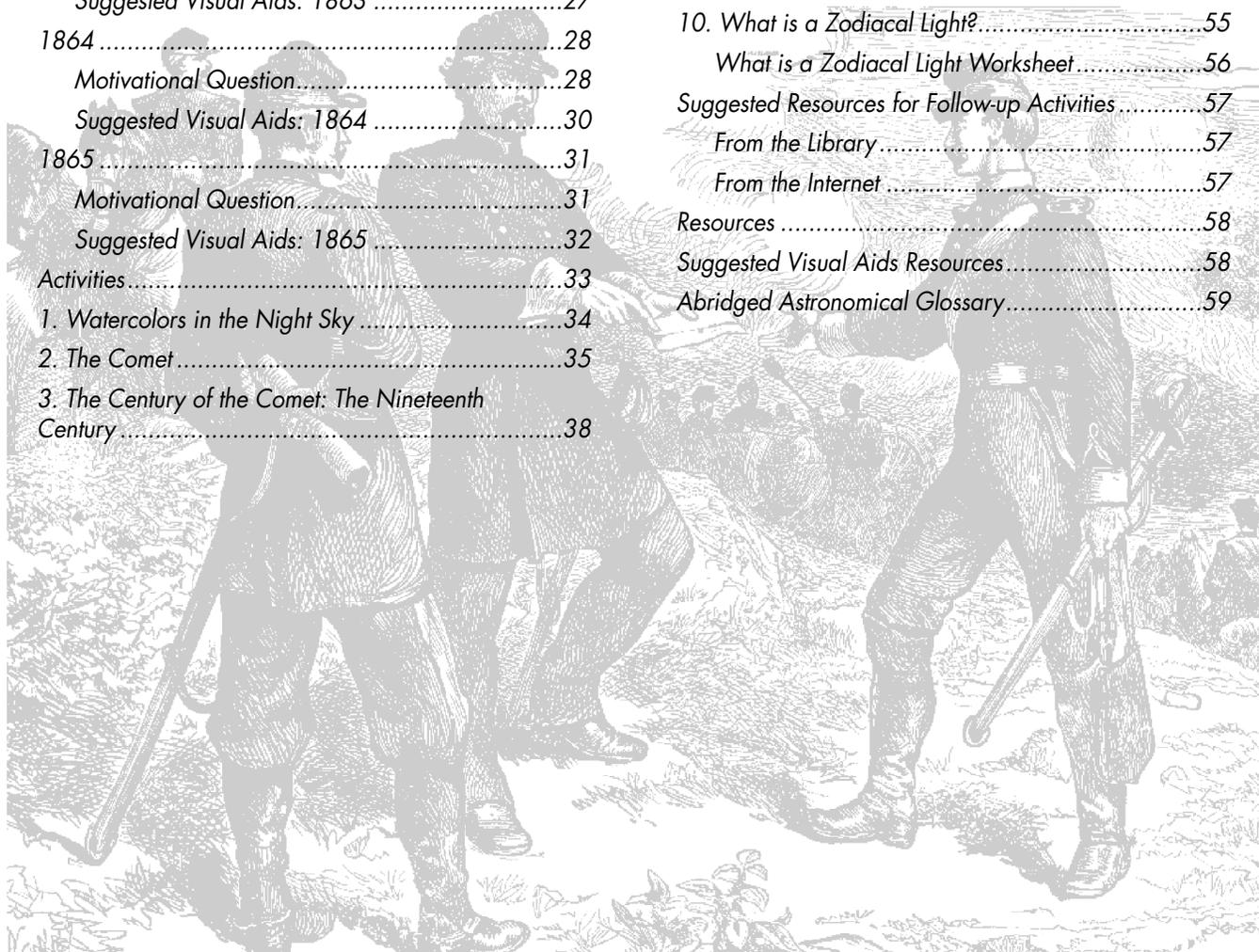


Including:

The Celestial Events During the American Civil War by Bernice-Marie Yates, Ph.D.

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The Celestial Events During the American Civil War



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Bernice-Marie Yates, Ph.D.

*By Bernice-Marie Yates,
Ph.D.*

This curriculum, The Celestial Events During the American Civil War, is the sole intellectual property of Bernice-Marie Yates, Ph.D., Franklin Township School, Quakertown, New Jersey. Comments and questions should be directed to the author.

Thematic Overview

An Introduction to the Celestial Events during the American Civil War

The Civil War has long been a topic of much interest in the United States as the number of re-enactors and Civil War Round Tables would attest. This period of American history fascinates us because most of us can trace our own heritage to its very roots. Whether our sympathies and affections are with the North or South, we love the era.

The Civil War Sky Cylinder and curriculum program endeavors to bring us closer to the mid-nineteenth century through a better understanding of the night skies of 1861-1865 and its relationship to the events that transpired on the North American continent. It brings the historian and astronomer together — not in the sense of archaeoastronomy but rather in the reality of specific encounters both earthly and astronomically.



Notes to the Teacher

This program is designed to be teacher friendly, student motivating and interdisciplinary. The program is divided into five units which may be presented as an individual unit of instruction or may be presented as a complete five-part unit:

1. Each unit is titled for a specific year of the American Civil War: 1861, 1862, 1863, 1864 and 1865.
2. Each year (or particular unit) consists of a script describing the history and astronomical events during that individual year of the Civil War.
3. The script is a guideline which parallels the scientific facts with the historical realities. The script may be read as it is written in a lecture format or may be used as supportive evidence for either the history or science teacher's own unique presentation style.
4. The script is supported by a suggested list of visual and audible aids to be utilized prior to and after the STARLAB presentation.
5. Setting the latitude — after the projector is set up, be sure to set the latitude to 35-40 degrees in order to have the cylinder in the correct position for desired viewing.
6. The post-STARLAB activities are interdisciplinary by design. The subject areas optimized are science, history, fine arts, language arts, geography and computer technology, therefore combining the talents of many teachers.
7. The post-STARLAB activities section includes a list of follow-up suggestions designed to extend the students' experience and stimulate further in-depth learning.
8. This program provides the STARLAB certified social studies teacher with the option of conducting the entire program (five-day plan) or just portions of the program (two-day plan), as desired. (The teacher should plan at a minimum two 45-minute classes, but it is recommended that the teacher plan five 45-minute classes for the entire program.)

Two-day Plan:

Day #1

- View the visual displays, maps. Listen to the period music.
- Introduction to the STARLAB
- Teacher-determined STARLAB Presentation

Day #2

- Related activities and closure to the single unit.

Five-day Plan:

Day #1

- View the visual displays, maps. Listen to the period music.
- Introduction to the STARLAB
- STARLAB Presentation: 1861

Day #2

- STARLAB Presentation: 1862

Day #3

- STARLAB Presentation: 1863, 1864, 1865

Day #4 & #5

- Related activities and closure to the complete unit.

Note

The teacher should take into consideration that their style of teaching may dictate a need for more or less time. Be sure to allow sufficient time for students to view the visual displays, absorb the STARLAB presentation thoroughly, complete an activity, expand their curiosity about American history and astronomy and, most importantly, to ask questions.

Preparation

Motivational Question of the Unit

Did the astronomical events during the mid-nineteenth century predict and parallel the American Civil War?

Objectives

After the planetarium program, the students will be able to:

1. Define and determine the differences between the terms zodiacal light, solar wind, aurora borealis, comet, asteroid and meteor.
2. Determine if any Civil War battles were actually impacted by astronomical events.
3. List the names of two historical figures from the Civil War who observed authentic astronomical events. Record their response to the events which they observed.
4. Recognize prevalent misconceptions which were popular in the nineteenth century concerning various astronomical events.
5. Draw a solar wind diagram.
6. Write a comparative essay using primary resource data.
7. Discuss a celestial poem by Oliver Wendell Holmes, Sr.
8. Write at least one poem pertaining to the STARLAB presentation.
9. Paint a facsimile of the aurora borealis in watercolors.
10. Write an essay explaining why the nineteenth century was known as the "Century of the Comet."
11. Recognize the astronomical discoveries in the nineteenth century.
12. Make a comet in the classroom.

Prior to the STARLAB Presentation

To set the mood and to motivate the students:

1. Mount a photographic display of prominent Civil War people or events named within the script. This should be located near the exterior of the dome along with a map or atlas of the divided nation. (A suggested list is stated at the conclusion of each script.)
2. Provide walk-in music, either inside or outside the dome. (Music should fade out prior to the STARLAB presentation.) Musical suggestions include CD or audio tapes of the following:
 - The soundtrack from Ken Burn's *The Civil War**
 - The soundtrack from *Gettysburg* (Available from any local music/sound store)
 - *Homespun Songs of the C.S.A.* — Bobby Horton
 - *Homespun Songs of the U.S.A.* — Bobby Horton (Available from Bobby Horton, 3430 Sagebrook Lane, Birmingham, AL 35243)
 - *Robert E. Lee Remembered* (Douglas Jimerson, Tenor) (Available from American music Inc., 14001 Berryville Road, North Potomac, MD 20874)

3. Set the mood in the dome — artificial non-heating fireplace logs are a nice touch as they provide a sense of being outdoors.
4. Obtain a pen light with a red cellophane overlay for the purpose of reading the script inside the STARLAB.

1861

Motivational Questions

Do you believe that astronomical events in the sky might have affected the Civil War? Have you ever seen a comet?

When Abraham Lincoln, a born Southerner, was elected President of the United States in 1860, eleven states located south of the 40 degree north latitude decided they could not survive under his leadership even though he was willing to compromise. Although Lincoln was firm in his beliefs, he wanted to resolve the national crisis without bloodshed. Consequently, the new president stated he had no plans to end slavery in those states where it already existed. Nevertheless, he made it very clear that he would not accept secession either.

On April 7, less than a month after Lincoln's Presidential Inauguration, a strange light appeared in the sky. This was a **zodiacal light** (a pillar of light, a bit fainter than the Milky Way that follows the ecliptic in the sky). It presented a mysterious quality with its alternating brightening and dimming. People did not know what to make of it.

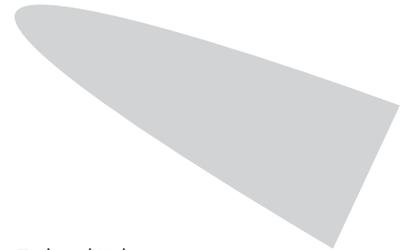
Then two days later on April 9, an **asteroid** or **minor planet** named **Maja**, was discovered in Cambridge, Massachusetts by H. P. Tuttle. By April 11th it was barely visible to the naked eye.

The very next day on April 10, and for several days afterward through April 29, a **comet** (a huge lump of ice and dust normally frozen solid that becomes visible as it grows near to the sun and the heat vaporizes the ice and gas spreading out in a long tail pointing away from the sun) was apparent. This was observed from Cambridge, Massachusetts and the Washington D. C. observatory. It was discovered by Albert E. Thatcher in New York City and remained visible until May 11, 1861.

Strangely enough, events were moving quickly toward Civil War in the United States for on April 11, the surrender of Fort Sumter was demanded by the Confederates. On April 12, 1861 Federal Major Robert Anderson, his second in command, Captain Abner Doubleday, and approximately 127 men refused to surrender. They defended Fort Sumter located in Charleston Harbor, South Carolina which had not received supplies since they took occupation on December 26, 1860. Their presence caused a crisis between the United States government and the newly seceded state of South Carolina.

Under the direction of Major General P. G. T. Beauregard, a former student of Anderson's from the United States Military Academy, batteries were mounted around the fort from the harbor's north and south shores, and from Forts Moultrie and Johnson. Fort Sumter was poorly defended with only 66 cannons, some of which were unmounted.

By 3:20 a.m. the crisis had come to an apex. After several demands of surrender, a final request to yield was mounted by Captain Stephen Dill Lee and Colonel James Chesnut. The two Confederate officers rowed out to the fort to make one last demand of compliance. Upon Anderson's refusal, Lee and Chesnut told him the fort would be shelled within the hour. Anderson was under the false hope that supplies and reinforcement were en route.



Zodiacal Light

At 4:30 a.m. the first Confederate shell exploded over Fort Sumter and the American Civil War had begun. Anderson mustered his small force and warned them to not take any unnecessary risks. Captain Abner Doubleday was presented the honor of returning the first Federal fire at about 7:00 a.m. The bombardment continued for 34 hours. As the Federal supplies were dwindling, Anderson ordered a restriction to use only 6 cannons since they were short of powder-bag cartridges. More than 40 loyal civilian workmen used any fabric available to make a supply of powder-bag cartridges. Anderson remained firm to the belief that aid was forthcoming and by the afternoon of April 12, the Federal supply ships had reached Charleston Harbor. Notwithstanding, Confederate guns kept the Federal ships from entering the fort.

The Federals concentrated their fire on a specific Confederate battery but little damage transpired. By dark, the Federals had ceased firing and the Confederates reduced their shelling to sporadic intervals. As dawn approached on April 13, three separate fires within the fort's interior threatened the powder magazine. Anderson was becoming desperate — many of the men were suffering from smoke inhalation and were not able to return a steady fire. Once again the Confederates resumed their heavy cannonade as dawn's light broke. Shortly before 1:00 p.m., a Confederate shell blew away Sumter's flag staff. Before it could be replaced, Confederate Colonel Louis T. Wigfall rowed out to the fort to demand surrender. Major Robert Anderson conceded.

The surrender ceremonies were held the next day on April 14, 1861. Major Anderson requested permission from General Beauregard to perform a 50-gun salute as the American colors were lowered. Permission was granted and as fate would have it, the 50th gun exploded killing one man and wounding several others. This incident created the only Federal casualties of the assault. The garrison was then transported to waiting ships outside the harbor.

Three days later on April 17 another **asteroid** named **Asia** was discovered in Madras, India by N. R. Pogson. It was of the 11th–12th magnitude and was the 4th planet discovered by Pogson.

While on the 18th both Northern and Southern shades of opinion were being expressed in the border and upper Southern states, there were some who were calling for neutrality or independence from either side. Various cities of the North were contributing money to aid volunteers enlisting in the Federal army.

As the month continued on, yet another **minor planet** named **Angelina** was discovered.

By April 29 the Maryland House of Delegates voted against secession 53 to 13 — a heavy blow to the pro-Confederate element in the state. The second session of the Provisional Congress of the Confederacy met in Montgomery, Alabama where Jefferson Davis gave a lengthy speech and powerful message for the Federal government, "All we ask is to be let alone."

By June, Virginia lost its western counties. Later this area would enter the Union as West Virginia. The month of June was crucial to four slave border states with divided loyalties. Delaware, Maryland, Kentucky and Missouri became pawns in a combination of political maneuvering and Federal military pressure to keep them from joining the Confederate States of America.

With public demands running high, General-in-Chief Winfield Scott ordered an advance on the South before Lincoln's citizen-soldiers were sufficiently prepared. The population in the Confederacy clamored for the fighting to begin. Although both sides were overly-confident and inadequately prepared for combat, Lincoln and Davis urged their respective armies to start offensive operations.

To the people in the 19th century, a comet was an omen, so when on June 30 the fabulous **Comet Tebbutt** presented its extraordinary display created by its close encounter with Earth, it served to further heighten the public excitement. Spotted in the Southern Hemisphere on May 13 at 4th magnitude, it moved north very slowly across Eridanus (the second longest, but only the sixth largest constellation in the sky). These faint stars have been known as "a river" with the star, Achernar, known as the "river's end." On June 8, Comet Tebbutt was of the 2nd magnitude. At mid month, it was of the 1st magnitude with a tail already 40 degrees long. Thereafter, its motion increased dramatically. On June 24, it was near Rigel at 0 magnitude. In conjunction with the Sun on June 29, the Earth passed through the comet's tail!

Then on June 30 in the Northern Hemisphere, it appeared suddenly in Auriga at dawn (located along the band of the Milky Way) as an immense, brilliant object. Descriptions suggest the head was at least -1 or -2 in magnitude. Its tail seemed to stretch from Auriga to Ophiuchus — 120 degrees.

On that same day just below New Orleans, *CSS Sumter*, commanded by Raphael Semmes, ran the blockade and, with three lusty cheers from the crew, began a spectacular career as commerce raider causing consternation to Federal shipping. *USS Brooklyn* gave chase but soon lost the *CSS Sumter*. It was reported by the astronomer Hubbard:

A brilliant comet crossed the skies. With a fiery head and a long streamer of light the dazzling comet cut across the mid evening in a sudden, unexpected visit. Was it just an astronomical phenomenon or was it prophetic of something more? One paper said the scientists were astonished, and they were timid frightened because it had 'taken the country by storm.'

On July 1 the Comet Tebbutt became circumpolar. Observations by Hubbard made on July 2, 3, 4 and 7, preceded the first major battle of the war — First Manassas (First Bull Run). However on July 2, the head of Comet Tebbutt was at 0 magnitude, with a tail 97 degrees long.

Famed Confederate cavalryman, Major General J. E. B. Stuart wrote to his wife about his activities which preceded the Battle of First Manassas:

On the 2nd, I (First Cavalry of CSA) captured one whole company, 15th Pennsylvania, officers and all — two privates of 2nd cavalry and a surgeon, including 48 stand arms and ammunition.

He continued:

During the last two days this regiment has been in the midst of the enemy.

Stuart said he was "before the enemy" and told his wife to "look out for stirring events here." The pattern of skirmishes and affairs had become evident nearly three months after war began.

On July 8, the **Comet Tebbutt**, now near Ursa Major was of the 1st magnitude with a tail up to 60 degrees long. A week later it was declining rapidly to 2nd and 3rd magnitude — it was visible but fading.

On July 16, Lincoln ordered Brigadier General Irvin McDowell to push the Confederate forces under the command of Beauregard and veteran Joseph E. Johnston, from the vital railroad center of Manassas Junction about 30 miles southwest of Washington, D. C. Notwithstanding, skirmishes took place sporadically early in July and



Comet Tebbutt

on July 21, but the battle actually began in earnest by midmorning when Colonel Nathan Evans' Confederates stood against the Federal attack force. Reinforcements were slow in aiding Evans. Finally, the troops of Barnard E. Bee and Francis S. Bartow were able to support Evans. The three Confederate officers held the line until they became outnumbered and were forced to retreat. McDowell sent in reinforcements across Bull Run to pursue the fleeing Confederates. Likewise, Beauregard and Johnson sent reinforcements to aid the retreating commands of Bee, Bartow and Evans. Among these reinforcements was Brigadier General Thomas Jackson, who held firm, like a "stonewall" in the rallying words of Barnard Bee. Charges and countercharges eddied from both sides for several hours.

By four o'clock in the afternoon the last of the Confederate reserve was spent, however, the humiliated and exhausted Federal line was slowly retreating across Bull Run. Suddenly a Confederate artillery shell struck a wagon in the path of retreat. This denied the Federals their primary retreat route through Centreville. Panic soon ensued from the Federal military and civilian spectators on hand to observe "the war."

Throughout the night, the Confederates celebrated their decisive tactical victory. This early encounter bolstered Confederate confidence enormously much to the chagrin of the terrified Federals filling the roads in hasty retreat toward the safety of Washington, D. C. The casualty numbers were low — 460 Federals killed, 387 Confederates.

This battle had a profound impact on the country. It certainly confirmed the belief that the war would be neither "romantic" or "brief." McDowell's failure to bring a quick resolve to the situation cost him the command of the Army of the Potomac. He was superseded by Major General George B. McClellan. Unable to move the Confederates out of the area of Manassas Junction, the Federals did not resume the offensive until March of 1862 under the new leadership of McClellan. On the 27th of July, George B. McClellan replaced Irwin McDowell as commander for the Federal Army of the Potomac.

By the end of the month, the **Comet Tebbutt** was in the 4th magnitude and President Lincoln nominated obscure Colonel U. S. Grant and others as Brigadier Generals of Volunteers.

Around June 30, 1861 the enthusiasm for war in both the North and the South was quite prevalent. Like Comet Tebbutt, which appeared with sudden immense prominence in Auriga at dawn on the June 30, equally magnificent and sudden was the rallying cries of "On to Richmond!" and "On to Washington!" As the brilliant comet faded, ever-decreasing in magnitude as the month of July, 1861 waned, so faded the splendid dreams of romance and immediate resolution of war.

Through the first half of August the comet was lost to the unaided eye and at the same time both sides readied themselves for the oncoming war.

As Robert E. Lee took on a prominent role as a military advisor to Confederate President Jefferson Davis, the west began to see bloody conflict at Wilson's Creek, Missouri by August 10. Although low on ammunition and unable to pursue the fleeing Federals, the Confederates legitimately claimed the victory by holding the field of battle.

On August 27, the **asteroid Melete**, also known as Daphne, was rediscovered.

During the weeks following First Manassas, Stuart directed several raids from his camp at Munson's Hill. On the 27th, Stuart ordered the Washington Artillery Battery to fire along Bailey's Crossroads to ascertain the Federal strength. A sharp clash oc-

curred against the Federals, who were unable to return fire. This maneuver provided Stuart with the necessary data regarding the strength of this Federal line as well as the ability to hold that position against any Federal advance.

In the autumn of 1861, the people from the North and South were asking where and when the next battle would take place. The neutral states were an immense barricade to military action from the Alleghenies to the Mississippi River. The people in the North and South remained optimistic but questions of all kinds were being asked everywhere.

By mid October, **the Orionids** made their appearance. They were joined in early November by **the Taurid meteor shower**.

Later in November, **meteors** known as **the Leonids** appeared as luminous streaks with fiery trails of particles from outer space burning up high in the atmosphere as reported by H. A. Newton, Twining and Herrick from the Connecticut Academy of Arts and Science in New Haven. Meanwhile early morning observations of meteors by F. W. Russell of Natick, Massachusetts took place during the first week in November.

Also on November 1, General Winfield Scott resigned as Commander-in-Chief of the Federal Armed Services. George B. McClellan replaced the retiring Scott. By the 3rd, Confederate Major General Thomas J. Jackson assumed command of the new Shenandoah Valley District as the Battle of Port Royal Sound, South Carolina commenced on the 7th.

Around this same time the beginning of the Trent Affair occurred. A Union warship, the *San Jacinto*, commanded by Captain Charles Wilkes intercepted the British mail steamer, the *Trent*, and seized two Confederate commissioners, James M. Mason and John Slidell en route to Great Britain and France, respectively, with the hope of gaining recognition for the Confederacy. The British Captain was reluctant to transfer the two agents, but acquiesced. The British and the Confederates were outraged. But by very slick maneuvering, the Federal Secretary of State, William H. Seward, was able to avert a disastrous incident. Before the incident was resolved, however, it brought the United States to the verge of war with Great Britain. Leaving Lincoln to quip, "One war at a time."

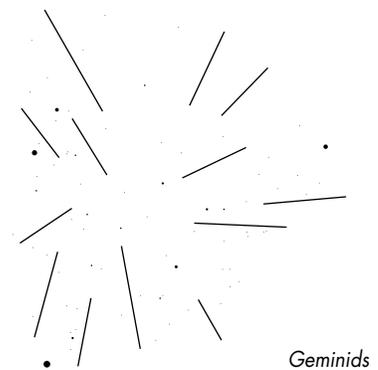
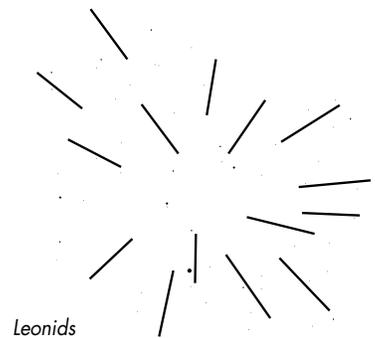
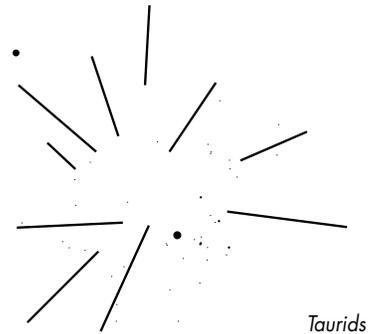
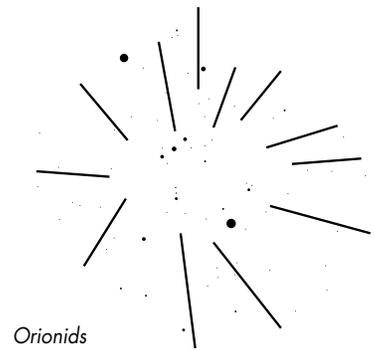
More good news for the Confederacy came by the middle of the month when they learned that Missouri, a border state, supported the CSA.

In December, the annual **Geminids meteors** appeared and were observed by G. W. Biddle, W. W. Johnson, H. W. Thayer, B. V. Marsh and G. Wood in varying numbers. By December 12, no fewer than 25 in the period of an hour and a half appeared.

About the same time, Federal Brigadier General George G. Meade and Confederate Cavalryman Jeb Stuart foraged in the area of Dranesville, Virginia.

Yet on December 7, the United States was treading on dangerous water as they seized a Confederate purchasing agent, J. W. Zacharie in the far west while the Trent Affair was still making headlines.

Skirmishes continued in the west through the remainder of the year. So as the end of 1861 came, the people from both North and South were left with sorrow, consternation and doubt.





Suggested Visual Aids: 1861

Maps

Large wall or free standing map of the "Divided Nation, 1861-1865" or the United States of America with a plastic overlay outlining the Confederate States of America.

Photographs

People

Abraham Lincoln, USA
Robert Anderson, USA
Abner Doubleday, USA
P. G. T. Beauregard, CSA
Stephen Dill Lee, CSA
James Chesnut, CSA
Louis T. Wigfall, CSA
Jefferson Davis, CSA
Windfield Scott, USA
Raphael Semmes, CSA
J. E. B. Stuart, CSA
Irvin McDowell, USA
Joseph E. Johnston, CSA
Nathan Evans, CSA
Thomas J. Jackson, CSA
Barnard Bee, CSA
George B. McClellan, USA
U. S. Grant, USA
Robert E. Lee, CSA
James M. Mason & John Slidell, CSA
William H. Seward, USA
George G. Meade, CSA

Places/Ships

Fort Sumter
Fort Moultrie
Fort Johnson
CSS Sumter
USS Brooklyn
Battle of Manassas/Bull Run
Washington, D. C. 1860s

1862

Motivational Questions

Have you ever seen an aurora? Have you ever hear of the Northern Lights?

On January 27, 1862, Lincoln issued a war order authorizing the Federals to launch a unified aggressive action against the Confederacy. McClellan ignored the order. With the false hope that McClellan would advance, Lincoln waited five weeks for McClellan to justify his "wait and see" decision. Finally on March 8, Lincoln, impatient with McClellan's inactivity, issued an order reorganizing the army and relieving McClellan of supreme command. McClellan was placed in command of the Army of the Potomac and ordered to attack Richmond.

March and April were marked by several events prior to the Peninsular Campaign. In an attempt to reduce the North's great naval advantage, Confederate engineers designed an ironclad vessel from a scuttled Federal frigate. Renamed the *CSS Virginia*, it fought to a tactical draw against the Federal ironclad *Monitor* on March 9, 1862. Nevertheless, the *Virginia* or *Merrimac* was able to destroy two Federal wooden warships off the coast of Norfolk, Virginia prior to this battle.

Meanwhile, Confederate Lieutenant General Thomas J. Jackson launched his Shenandoah Valley Campaign with the First Battle of Kernstown on March 23. This valley campaign extended into early June with such engagements as the Battle of McDowell on May 8, Battle of Front Royal, May 23, First Battle of Kernstown on March 23, First Battle of Winchester, May 25 and the Battles at Cross Keys and Port Republic, June 8-9.

In the west on April 6, U. S. Grant's Federal troops nearly met with defeat at the Battle of Shiloh, Tennessee. Darkness ended the battle with the Confederates in command of the field. By morning the Federal troops were reinforced and the command of the field was reversed. The Confederates were forced to retreat, however, the exhausted Federal troops did not pursue them.

By April 25, U.S.N. Flag Officer David Farragut had obtained victory on the Mississippi River and was in command of New Orleans. McClellan had finally decided to move and by May 4, the Army of the Potomac occupied Yorktown, Virginia. McClellan met strong resistance from James Longstreet's Confederate troops forcing him to conclude that he had to await reinforcements.

The Battle of Fair Oaks (Seven Pines) took place on May 31 and June 1. Only last minute reinforcements saved the Federal army from serious defeat. The Confederates lost the services of General Joseph E. Johnston, who was severely wounded. The new commander of the Army of Northern Virginia was Robert E. Lee.

Between June 26 and July 2 the following battles took place: Mechanicsville, June 26-27; Gaines' Mill, June 27; Savage's Station, June 29; Frayser's Farm, June 30 and Malvern Hill on July 1. When the Confederates redeployed to Richmond on July 2, the Peninsular Campaign ended. This campaign changed the course of the war in Virginia. Lee gained strength by reorganizing the army into two corps under Longstreet and Jackson. McClellan remained on the James River, blaming Lincoln for his defeat and asking for more reinforcements. Nine days later on July 11, Henry Halleck was named general-in-chief of the Federal army.

The **Comet Swift-Tuttle** was discovered by Lewis Swift on July 16, 1862. It was considered to be equal to a star of the 7th magnitude with a very slow



Comet Swift-Tuttle, July 1862

movement. The comet lingered well into September although it was difficult to view without the aid of a telescope.

Although most superstitious celestial gazers considered it a symbol of doom associated with the Battles of Shiloh and Williamsburg, it actually was the precursor to the Battle of Sharpsburg or Antietam. The reason for the error in battles was due largely to slow and inaccurate communications.

With Richmond secured after his victorious Seven Days' Campaign, July and August saw Robert E. Lee shift operations to north-central Virginia, shuttling his army in stages northwestward against the newly created Federal army under the direction of Major General John Pope. Lee decided to take a bold move against Pope, whose 75,000 men were located on the north side of the Rappahannock River. On August 25, Jackson's famed foot cavalry began a wide flanking march around Pope's right to sever his lines of communication and supplies, and to gain access to a huge Federal supply depot at Manassas Junction. On the 27th of August, Pope abandoned his position moving northward. Lee, traveling with Major General James Longstreet, departed from their Rappahannock area to join forces with Jackson.

By August 28, the armies of Thomas J. Jackson and John Pope met at an area known as Groveton. The Federal commander Pope ordered a concentration of his army on the old Manassas battlefield. These singular events laid the foundation for the beginning of the Second Battle of Manassas.

Federal General Pope fought the ensuing battle with great energy but with defective tactics and judgment. Pope decided to concentrate his army against Jackson, therefore neglecting the approach of Longstreet who entered the area from the west via Thoroughfare Gap on the evening of August 28.

While in Marseilles, France between August 29 and 30, the discovery of a new **asteroid** named **Galatea** was made by M. Tempel. It was of the 11th magnitude — not very bright but it occupied scientific attention.

As the morning of August 29 approached, Pope hurled his whole division as well as a few divisions from McClellan's Army of the Potomac, against Jackson's strong defensive position along an abandoned railroad embankment in a wooded area. Jackson's Confederates repulsed six bloody assaults by the right half of Pope's joint forces. A subordinate Federal officer, Major General Fitz John Porter, failed to attack Jackson's flank due to Longstreet's presence.

As night fell, Lee pulled back a few units to buttress the line. Pope misinterpreted this retrenchment as a retreat and as a result decided to advance on the morning of the 30th to cut what he thought was the Confederate line of retreat. As the Federals advanced, Jackson was waiting. Jackson battered the charging Federals, as Lee ordered Longstreet to counterattack with a relentless forward maneuver with 30,000 men. The entire Federal line crumbled under the assault. The Confederates pursued them for more than a mile before the Federal rear guard halted the Confederate advance.

The demoralized Federal army regrouped on August 31. Much to Pope's dismay, McClellan sent two corps to support him but they arrived too late.

As if to celebrate the Confederate victory, an **aurora borealis** occurred on the evening and early morning of August 30 and 31. An aurora borealis is a luminous phenomenon that consists of streamers or arches of light in the night sky. It is produced by a solar wind which blows against the magnetosphere, a giant magnetic field that surrounds the Earth.



Aurora Borealis

Realizing the Federal's weakened circumstances, Lee took advantage of the situation by ordering Jackson to a position west of Chantilly, Virginia. The next day, September 1, Jackson's advance resulted in the Battle of Chantilly. Overwhelmed, Pope withdrew his humiliated army closer to Washington. This battle ended the Second Manassas Campaign with a glorious victory for the South.

In Washington, Pope blamed McClellan and his officers for not reinforcing him adequately and quickly. Lincoln and his cabinet considered McClellan's lack of cooperation "unpardonable."

Though many cabinet members demanded that McClellan be court-martialed, Lincoln realized that McClellan's popularity with the men was his only redeeming attribute. Lincoln decided to have McClellan reorganize the disheartened army and resume command of the entire Federal army on September 2. However, it was not until September 7 that McClellan chose to move the Federal troops out of Washington.

On September 4, the Army of Northern Virginia crossed the Potomac river into Maryland. Confident after their marvelous victory at Second Manassas, R. E. Lee concentrated his men in Frederick, Maryland on September 7. It was at this location that Lee formulated the details of the Maryland campaign.

Uncertain of Lee's plans or location, McClellan moved cautiously into Maryland. On the 10th, he learned that the Confederates had evacuated Frederick and his pursuit quickened.

Once again the **asteroid Daphne** was rediscovered between September 5 and 11. Proof of rediscovery was verified by the same orbit it used in the original sighting in 1856.

Lee decided to divide his army for the third time. Shielded by South Mountain, Lee planned to move his army north into Pennsylvania. The purpose of this move was to earn European diplomatic recognition for the Confederacy and perhaps force Lincoln to sue for peace.

Lee sent Jackson to open a supply line into the Shenandoah Valley. To accomplish this Jackson needed to secure the garrison at Harpers Ferry. After capturing this garrison, Jackson reunited with Longstreet. Lee believed he could reunite his divided troops before the Army of the Potomac could attack their weakened force.

By September 12, the Federals entered Frederick. The next morning they had a good piece of luck. Two infantrymen seated at an abandoned Confederate campsite found two cigars wrapped in paper. The paper was a copy of Lee's Special Order 191. Realizing the importance of this paper, the information was quickly sent to McClellan. McClellan was suddenly presented with an opportunity to destroy Lee's divided army. Nevertheless, he waited 16 hours before moving.

Within 24 hours, Lee learned of this misfortune from Major General J. E. B. Stuart. Lee not only had to abandon his plans for a northern invasion, but possibly face the obliteration of his partitioned army. Longstreet was near Hagerstown, Jackson was advancing on Harpers Ferry, while Lee had only one infantry division at Boonesboro and Stuart's horse artillery to hold the gap at South Mountain.

On the morning of the 14th, the Federal columns were approaching the Confederate defenders commanded by Major General D. H. Hill. A sharp battle occurred, but Hill fought on despite mounting odds. After an assault by the Federal First Corps, Hill shifted his five brigades against this onslaught. Finally, Longstreet was able to reinforce Hill late in the afternoon, therefore averting disaster for the Southerners. Although Lee's supply trains were secure and he had an extra day to regroup, he decided to prepare orders for a retreat into Virginia.

Notwithstanding, on the morning of the 15th, Jackson captured Harpers Ferry. News of Jackson's success altered Lee's strategy. He ordered a concentration at Sharpsburg, Maryland.

On September 16th the **asteroid Galatea** was observed again.

Lee gathered his troops all day on the 16th. Jackson arrived after an all-night forced march, leaving behind a division to complete the control of the area. A nighttime rain fell on the troops and by dawn on the 17th, a dense fog shrouded the battlefield. McClellan's battle strategy to attack both Confederate flanks soon faltered due to a series of uncoordinated, half-hearted assaults. Hammering Federal strikes were met by pounding Confederate counter strikes. Artillerists on both sides defaced the countryside with charred foliage and bloody bodies. Lee skirted the thrusts by shifting troops from his right to the left and center.

The failure of Federal General Ambrose Burnside to pounce on the Confederate right gave R. E. Lee the time to redeploy his units. Outmanned nearly two to one, the Confederates were able to repulse Burnside's tardy onslaught only due to the arrival of Jackson's absent division who had completed their assignment in Harpers Ferry. When the day ended, it was to be known as the bloodiest day of the war.

Both armies were exhausted. By the evening of the 18th, Lee ordered a retreat across the Potomac into Virginia. McClellan sent a force in pursuit on the 20th but they were repulsed by Jackson. Although the result was a virtual stalemate, McClellan claimed victory when Lee fell back across the Potomac, ending his first offensive invasion of the North.

The battle convinced the British and French, who were contemplating official recognition of the Confederacy, to reserve action. This gave Lincoln the opportunity to announce his preliminary Emancipation Proclamation on September 22.

As fate would have it on that very day, there was still another observation of the **asteroid Galatea** and the discovery of a new asteroid of the 11th magnitude, located by C. H. F. Peters of New York. Astronomer Stillman Masterman of the Weld Observatory located in Franklin county, Maine, witnessed eight meteors, the flights of which five conformed to a circle of five degrees. On September 25-28 there were continued observations of the asteroid Galatea. It was considered the minor planet — one of doom.

On September 28, Richmond received notification of the Emancipation Proclamation. Although McClellan remained on the field, to many people Antietam (Sharpsburg) seemed a halfhearted effort on his part.

On October 1, Lincoln and a staff of advisors traveled to Harpers Ferry to confer with McClellan. McClellan did not meet them. Again Lincoln was snubbed by his brash general. This time Lincoln decided to embark for the headquarters of the Army of the Potomac in Maryland for conferences and reviews of the troops. After seeing the camp, Lincoln commented, "This is General McClellan's bodyguard." By the afternoon of October 4, Lincoln returned to Washington disturbed by McClellan's delays and attitude.

By the 10th of October, J. E. B. Stuart had moved north toward Chambersburg, Pennsylvania with 1,800 men to cut off McClellan's supply route. Aware of a Federal pursuit and after completing his objective, Stuart lead his command southward in the opposite route taken northward. In effect, Stuart had ridden completely around McClellan again (the first time was in June of 1862 during the Peninsula Campaign). In Stuart's two day spree, he managed to severely disorganize the Federal cavalry for weeks and cause an already timid general to be more fearful.

The end of October witnessed no immediate threats from a Confederate invasion of the North, but changes were afloat.

On October 21, discovery was made of a new **asteroid** named **Freya** for the goddess of love and beauty in Scandinavian mythology. It was of the 12th magnitude. Then late in October at sunrise, prior to Mars setting in the west, **the planets Saturn, Jupiter, Venus and Mercury aligned vertically** in the east. This unusual occurrence became another omen of the pending earthly events to 19th century Americans and Europeans. This was immediately followed in early November by the **Taurid meteor shower** and later in the month by the annual **Leonid meteor shower**.

Before the first week of November had concluded, Lincoln sent the following order: "By direction of the President, it is ordered that Major General McClellan be relieved from the command of the Army of the Potomac and that Major General Burnside take the command of that army." McClellan was relieved of command on November 7, 1862 — his military career was over. At his farewell on the 10th, the idolized McClellan was cheered by the men from his former command. Their emotional outburst presented a problem for Burnside, who assumed full command the previous day.

On November 11, like the command of the Federal General McClellan, **3 meteors** that were observed shooting from the north and appeared without any train. Their flights were pale and wavering.

At the same time, the Confederates received confirmation that Federal George B. McClellan had been replaced by General Ambrose Burnside.

Then on November 12, Masterman observed **4 bright stars** radiating from the triangle made in the Persei group: Schedar, Persei and Auriga. These flights were massive and well established. The three had trains of brief duration. The sky was brilliant.

Two days later, meteors were observed in Leo and the trains of which were observed near Orion by Thomas H. Battey. These flights left no trace and were at very obtuse angles as they formed a line from themselves to the constellation Leo.

At this time Lincoln approved Burnside's suggestion to reorganize the army and drive toward Richmond. On Sunday, November 15, the Army of the Potomac began moving from Warrenton, Virginia toward Fredericksburg.

On that same day a **meteor shower** was noted but it was difficult to see unaided due to the bright moonlight and its somewhat imperfect sky.

The end of the month witnessed far less fighting, command changes and advantageous positioning for the next battle. The advent of December saw the Confederacy on the defensive. The Army of the Potomac was in Virginia and the Army of Northern Virginia was waiting for Burnside's Federals to strike.

On November 19, 1862, Major General Ambrose E. Burnside's Army of the Potomac, approximately 130,000 men, were encamped on the east bank of the Rappahannock River facing Fredericksburg, Virginia waiting for pontoons to arrive. The pontoons finally arrived on November 25 but Burnside delayed another 3 weeks before attempting to cross the river.

With this delay, General Robert E. Lee was able to reinforce his position with Lieutenant General James Longstreet and Lieutenant General Thomas J. Jackson by fortifying the heights west of the city. Lee placed Longstreet on the left along a ridge known as

Saturn ●

Jupiter ●

Venus ●

Mercury ●

Vertical Alignment, October 20, 1862

Marye's Heights. To further enhance his position, Longstreet was fortified by a sunken road and a stone wall at the base of the heights. Jackson took a position on the right with about 75,000 men.

Despite the topographical advantage and strength of Lee's Confederate position, Burnside finally decided to attack on December 13. He ordered a frontal assault by Major General Edwin V. Sumner on the right, Brig. General William B. Franklin on the left and Major General Joseph Hooker in the center in reserve. All day the Federals charged the nearly impregnable Confederate position only to be beaten back each time with heavy losses. Darkness put an end to the useless slaughter. The Federal casualties numbered 12,653 to the 5,309 men lost to the Confederates. December 12 to 14, the Battle of Fredericksburg, was a major Confederate victory.

There remains some controversy concerning the actual evening of the aurora borealis (see Eyewitness Accounts of Civil War Officers, next page) — December 13 or 14? Due to the fact that the battle took place on December 13, it is quite logical that the display of northern lights occurred on that same evening (most likely the evening of December 13 into the early morning hours of December 14).

Later, on the evening of December 15 in a violent rain storm, Burnside finally withdrew his troops across the Rappahannock River, destroying the bridges behind him. This concluded active campaigning in the east for 1862.

Eyewitness Accounts of Civil War Officers

Then on December 13-14, by an eyewitness report of the sighting of the aurora borealis — Confederate perspective:

Jedediah Hotchkiss, Topographer for Lt. Gen. Thomas J. Jackson, Army of Northern Virginia. Personal Journal Entry from Sunday, December 14, 1862:

Went to the battle field early this morning expecting a renewal of the fight but everything was quiet save some occasional artillery firing from both sides. The enemy opened on a battery that was being placed in Hood's line at the corner of the woods. In the morning A. P. Hill's Division was relieved from the front line of battle and Taliaferro and Early took his place; D. H. Hill was put in the second line and A. P. Hill in the third in reserve. The enemy held his position on the bottoms of the Rappahannock, Capt. Boswell, of the Engineers, dug pits on our right for sunken batteries. The General [Jackson] went to the front at 5 a.m.. Hd. Qrs. last night at Curtis' Shop near Darnabus' Pond; during the day they were at Marye's [Hamilton's] house near Hamilton's Crossing of the R. F. & P. railroad. Last night there was a grand Auroral display, one of the finest I have ever seen; the day has been very pleasant.

Hotchkiss, Jedediah. Make Me a Map of the Valley: The Civil War Journal of Stonewall Jackson's Topographer. Dallas: Southern Methodist University, 1989, 100-101.

Robert Stiles, Major of Artillery, Army of Northern Virginia. Personal Diary:

The battle closed, as it began, with a marked, and this time a beautiful, natural phenomenon. It was very cold and very clear, and the aurora borealis of the night of December 13th, 1862, surpassed in splendor any like exhibition I ever saw. Of course we enthusiastic young fellows felt that the heavens were hanging out banners and streamers and setting off fireworks in the honor of our victory. Our friends, the enemy, seemed in no hurry to leave our neighborhood, though they did not seem to long for another close grapple, and as we appeared equally indifferent to any closer acquaintance with them General Burnside and his army, on the night of December 15th, apparently insulted, retired to their own side of the river and began to get ready for Christmas.

Stiles, Robert. Four Years under Marse Robert. Atlanta: R. Bemis Publishing, Ltd., 1903, 137.

Secondary commentary on the "northern lights."

Douglas Southall Freeman. Lee's Lieutenants:

Slowly the Federal bombardment, like the barking of a dog that has driven off an intruder, halted, rose again for an instant and then died growlingly away. Darkness fell, but not for the undisputed reign of the long December night. Soon from beyond the Confederate left, far up the Rappahannock, there rose a glow. What was it? Had some forage depot caught afire? Was Wade Hampton duplicating Jackson's feat at Manassas Junction? The sky flushed and grew dark again. Now shining white, it reddened and dimmed and blazed once

more till it lighted the faces of the marveling soldiers. It could be nothing less than that of which Southern boys often heard, though never had they seen it — “northern lights,” the fantastic sky-painting of the aurora borealis. The spectacle awed but it flattered.

Freeman, Douglas Southall. *Lee's Lieutenants*. Vol. 2, New York: Charles Scribner's Sons, 1942-44; 373-374.

**Night Sky of December 14, 1862 — Federal perspective:
Joshua Lawrence Chamberlain, Colonel of the 20th Maine, Army of the Potomac:**

Darkness fell on the heights and plains behind Fredericksburg as the day slowly ended. The men could stretch and move a little now, drink some water, and get something to eat from their haversacks. Later more Union men would come to take the places of Griffen's Third Brigade, and they could hurry back to the city with their wounded, glad to leave that place. But now there was a sorrowful duty to perform — the regiments must bury their dead. The Twentieth Maine soldiers carved rude headboards for each man from some debris, shadowed matches in cupped hands for light, and scratched shallow graves in the muddy soil. *They planned a burial for their fallen comrades lighted only by the stars, but nature, in a rare display for those latitudes, cooperated to make, as it had for Viking warriors, 'a more sublime illumination.'*

Trulock, Alice Rains. *In the Hands of Providence*. Chapel Hill: University of North Carolina Press, 1992; 100

As we bore them, the forms of our fallen heroes, on fragments of boards torn from the fences by shot and shell, to their honored graves, their own loved North lifted her glorious lights, and sent her triumphal procession along the arch that spanned her heavens. An aurora borealis, marvelous in beauty. Fiery lances and banners of blood, and flame, columns of pearly light, garlands and wreaths of gold—all pointing and beckoning upward. Befitting scene! Who would die a nobler death, or dream of more glorious burial? Dead for their country's honor, and lighted to burial by the meteor splendors of their Northern home!

Chamberlain, Joshua Lawrence. *Letter of December 17, 1862*, Pejepscot Historical Society, Brunswick, Maine.

Many saw this display as yet another omen. A Scottish immigrant woman living in Fredericksburg wrote in her diary after she observed the aurora's brilliance, the following passage from W. E. Aytoun's *Edinburgh After Flodden*:

All night long the northern streamers

Shot across the trembling sky:

Fearful lights, that never beckon

Save when kings, or heroes die.

Suggested Visual Aids: 1862

Maps

Large wall or free standing map of the "Divided Nation, 1861-1865" or the United States of America with a plastic overlay outlining the Confederate States of America.

Photographs

People

Abraham Lincoln, USA

George B. McClellan, USA

Thomas J. Jackson, CSA

David Farragut, USA

James Longstreet, CSA

Joseph E. Johnston, CSA

Henry Halleck, USA

Robert E. Lee, CSA

John Pope, USA

Fitz John Porter, USA

J. E. B. Stuart, CSA

Daniel H. Hill, CSA

Ambrose Burnside, USA

William Franklin, USA

Joseph Hooker, USA

Jedediah Hotchkiss, CSA

Robert Stiles, CSA

Joshua Lawrence Chamberlain, USA

Places/Ships

Richmond, Virginia, 1860s

Peninsular Campaign Map

Monitor and Merrimack

Map of Jackson's Valley Campaign

Battle of Shiloh Map

Battle of 2nd Manassas Map

Harpers Ferry, West Virginia

Battle of Sharpsburg /Antietam Map

Facsimile of the Emancipation Proclamation

Battle of Fredericksburg Map

1863

Motivational Question

Did the observation of meteor showers and comets mark the turning point in the Civil War?

As the new year of 1863 approached, people both North and South wondered what Lincoln's Emancipation Proclamation would really mean. Since the beginning of the war a whole new way of life had evolved. It was evident in political changes, economic changes, social changes and spiritual changes.

January 3rd marked the annual visitation of the **Quadrantid meteor shower**, which was very brilliant but the harsh cold weather made it difficult to observe for long periods of time.

During this time frame from January 1-3, 1863 a large delegation of Democrats had a meeting in New York City with a select delegation from New Jersey, who presented a peace proposal based on the "old Union" theory to the Federal Government and the Confederacy. The convention was unsuccessful.

Aside from the Battle of Murfreesboro and Stone's River in the west in early January, little other important action transpired until mid-March. The night skies apparently were quiet also.

But by March 15, the discovery of the **asteroid Diana** was made with continued observations on the 21st, 25th, and 31st.

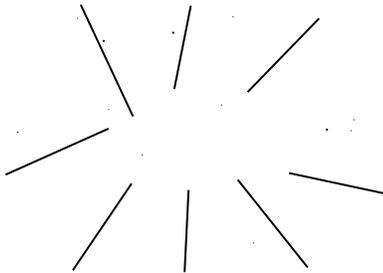
Between the 15th and 21st the Battle of Kelly's Ford occurred killing one of the brightest young Confederate officers, Major John Pelham, or as R. E. Lee called him, "the Gallant Pelham." It was also known by this time, that the Confederacy was desperate for fighting men. On the 25th and 31st, there was scattered action in the west from U. S. Grant and Admiral David Farragut on the Mississippi River.

On April 12th a **new comet** was discovered in Germany and then in Italy on the 15th, but by mid-May it had faded. It was only 10 degrees from Polaris giving a round nebulousity for 5-6 minutes.

Then on April 13, another **new comet** was discovered near Pegasus. The nucleus had a brightness of a 6th magnitude and the tail extended in a 40 degree arc. But by the end of the month, the comet was fading rapidly with its tail only 2 degrees in length. During this period when two new comets were discovered in the night skies, the events on earth were turning toward war again.

On April 13, Jefferson Davis was very ill and his wife was away with her parents. By the 25th, Grant and the Federal army were advancing upon Vicksburg and the Armies of the Potomac and Northern Virginia were setting the stage for a showdown near the Chancellor House at a crossroad outside of Fredericksburg called "Chancellorsville." Perhaps these comets foreshadowed events to come. By May 19, 1863 the Confederacy had its greatest victory, but it was bittersweet due to the death of Thomas "Stonewall" Jackson on May 10. Yet, Grant's siege of Vicksburg in the west was just beginning by the 19th.

In the east by early June, Lee struck out on another bold strategy and J. E. B. Stu-



Quadrantids

art was engaged in the largest cavalry battle to be orchestrated on the Northern Hemisphere, the Battle of Brandy Station near Culpeper, Virginia. Even though Stuart retained the field, he learned a valuable lesson — the Federal cavalry was now prepared to meet and fight him on more equal terms.

Lee's plan was to strike in the North again, hope for victory and ask Lincoln for terms to end the conflict. The Confederate objective was Harrisburg, Pennsylvania. But as providence would have it, the turning point in the war happened in a small town south of Harrisburg called "Gettysburg." At the end of three days of bloody fighting, Lee started his retreat for the safety of Virginia. Meade did not pursue him. Again fate stepped in — the same day Lee was defeated in Gettysburg, Grant accepted terms of surrender in Vicksburg. The tide had turned in favor of the Federal government and army. It was mid-September before any other major confrontation took place in the east or west.

On September 14, Prof. James C. Watson from Michigan discovered **Eury-nome, a minor planet**.

At this time, Tennessee had fallen to the Federals and there was another cavalry confrontation near Brandy Station, Virginia. This time the Confederate cavalry retreated from the field.

By the end of the month, the stage was being set for the Battle of Chickamauga, Georgia. Action took place in the west but it was October 9 before General Lee's Army of Northern Virginia moved. The two armies came to blows once more at Bristoe Station, Virginia on the 14th. The campaign lasted until the 22nd of October. The Bristoe Campaign had been one of maneuvering, with several opportunities lost on both sides. Lee had failed to intercept the Union retreat and the campaign had no significant strategic result, but Lee's brilliant maneuvering succeeded in pushing Meade back 40 miles and denying him the use of the railroad for six weeks. The campaign illustrated the principle of the offensive which made Lee a great general. The end of October saw confrontations in Chattanooga, Tennessee and heavy shelling in Charleston, South Carolina.

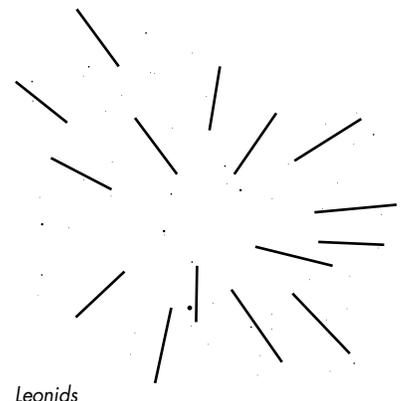
This new "**planet**" **Eury-nome** continued to be observed though the entire month of November.

Engagements along the Rappahannock brought Lee and Meade together again. The Federals were actively bombarding Fort Sumter in Charleston harbor in order to regain control of the fortress. Federal General W. T. Sherman joined forces with Grant to move on Chattanooga, Tennessee.

On November 19, Abraham Lincoln traveled to the small town of Gettysburg, Pennsylvania to dedicate a portion of the battlefield as a final resting place for those who had fought and died there in July. His two-minute address became among the best known in American historical literature.

One of the largest **Leonid meteor shower** displays occurred in mid-November radiating from the sickle of Leo. It was observed from various sites:

- Washington, D. C. — Lt. Gilliss of the U. S. Federal Naval Observatory observed 213 meteors, duration of 0-37 seconds
- Haverford College, PA — 316 meteors, duration of several per hour, the most of which were observed between the early morning hours: 67 at 2 a.m., 69 at 3 a.m., 64 at 4 a.m.
- Germantown, PA — 97 meteors between the hours of 1-5 a.m.
- Philadelphia, PA — 55 meteors, 6 of which were of the first magnitude



- Easton, PA — 27 meteors
- West Chester, PA — 56 meteors as seen in Washington, D. C.
- Belvidere, NJ — Rev. H. S. Osborn saw 3
- Norfolk, VA — Capt. C. E. Dutton of the Confederacy and an assistant watched at 3 a.m.. Both looked to the constellation Leo, and saw 36 meteors during the first hour, most of them very small. The paths of all except 4, could be traced back to have passed through the sickle in Leo. During the next half hour they looked in opposite directions, and saw in that period 43 meteors.
- In the midwest (OH) — 34-105 meteors were observed in the same time period. Many of the flights were mapped on the chart, and these varied in an arc of 2-25 degrees. One of the longest lay in Perseus and remarkably exhibited a continuous curve, having its termination at about a right angle to its beginning.

U. S. Grant of the Federal Army and Braxton Bragg of the Confederate Army were in the midst of the Chattanooga Campaign during the period of planet and meteor observations. At the end of the month the Battles of Chattanooga, Look-Out Mountain, and Missionary Ridge were all Federal victories. The Confederacy not only lost the battles but the weary major field commander, Braxton Bragg, felt he was no longer suitable for duty and resigned.

By December, many were wondering how much longer the South could hold out. Politics came to the forefront in the North as the presidential election year of 1864 approached. The people of the North and South were growing increasingly tired of war but the certainty of its conclusion in 1864 was not guaranteed.

Many soldiers from both North and South observed the meteor shower as seen by the professional and amateur astronomers. However, only two military men recorded their findings, Federal Naval Officer Lt. Gilliss and the Confederate Capt. C. E. Dutton.



Suggested Visual Aids: 1863

Maps

Large wall or free standing map of the "Divided Nation, 1861-1865" or the United States of America with a plastic overlay outlining the Confederate States of America.

Photographs

People

Abraham Lincoln

John Pelham, CSA

Robert E. Lee, CSA

David Farragut, USA

Jefferson Davis, CSA

U. S. Grant, USA

Thomas J. Jackson, CSA

J. E. B. Stuart, CSA

George G. Meade, USA

W. T. Sherman, USA

Braxton Bragg, CSA

George H. Thomas, USA

Places/Ships

Facsimile of the Emancipation Proclamation

New York City, 1860s

Battle of Murfreesboro Map

Battle of Chancellorsville Map

Battle of Brandy Station Map

Battle of Gettysburg Map

Siege of Vicksburg Map

Battle of Chickamauga Map

Bristoe Campaign Map

Chattanooga Campaign Map

Charleston, South Carolina

1864

Motivational Question

What obvious evidence was there that the South was losing the war?

By the third winter of the war, the Federal war objective was clear, made so by policy and action, implemented by manpower and material supremacy. It became a war of attrition. Emancipation was an irrevocable commitment. Military conquest of the Confederacy was relentlessly pursued.

The South was being pressed inward. Their dreams of Northern collapse, foreign intervention and military victories were more and more unrealistic. It was time for regrouping, reassigning commanders and soul-searching. Since November there had been no major military action and none was foreseen in immediate future. The South seemed to be tearing itself apart along with the efforts of Northern invader. It was months before any real action occurred.

Then on April 19, a **comet** appeared near the constellation Lyra. It was discovered by Alex Herschel. Perhaps this comet marked the pending doom and destruction of the Confederate States of America.

In May, U. S. Grant was promoted to commander of the Federal armies. His strategy was simple — engage Lee's forces in Virginia until they were destroyed. Grant's strategic victory in the Wilderness Campaign, as well as Yellow Tavern, Spotsylvania and Cold Harbor, and Sherman's march on Atlanta, Georgia marked the beginning of the end for the Confederate States of America. The Atlanta Campaign stretched from May to September. Sherman met resistance every mile of the way from General John Bell Hood who replaced Joseph E. Johnston.

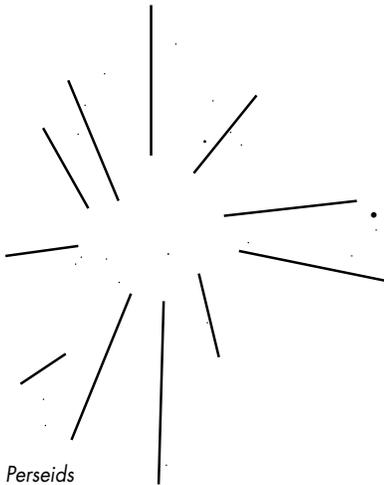
The nights of August 9-12 were marked by the **Perseid meteor shower**. To many people this event pointed to the demise of the Confederacy. The meteors were best seen beginning well after midnight.

Since Grant had not taken Petersburg and Richmond ending the war, many were faced with horror at the prospect of another fall and winter of warfare. As the summer closed, the Democratic candidate for President of the United States was selected in Chicago. They named the former Major General George B. McClellan.

Atlanta, second only to Richmond in importance to the Confederacy, was evacuated on September 1. The next day Sherman took control of the city. Confrontation after confrontation saw the steady downfall of the Confederacy. Although the Confederacy still retained many formidable commanders like Generals Jubal Early, and James Longstreet, the lack of fighting men and supplies attributed to the success of Grant's war of attrition.

November, 1864 commanded national attention in the South as well as in the North. The outcome of the presidential election was critical to both sections. Lincoln was reelected by a wide margin over his opponent, McClellan, who carried only three states — Delaware, Kentucky and New Jersey. McClellan's popularity as general was not sufficient to overcome the proven strength of Lincoln.

The month ended with the Battle of Franklin. Even though Federal General John M. Schofield revealed himself to be a dreadful commander, this battle was a terrible disaster for Confederate General John Bell Hood who lost 6,200 men in the battle.



The December winter did not slow down military operations. Sherman was closing in on Savannah, Georgia as the combined forces of John M. Schofield and George H. Thomas still faced John Bell Hood in the front lines at Nashville, Tennessee. Both Nashville and Savannah fell prior to Christmas. It was just a matter of time.



Suggested Visual Aids: 1864

Maps

Large wall or free standing map of the "Divided Nation, 1861-1865" or the United States of America with a plastic overlay outlining the Confederate States of America.

Photographs

People

U. S. Grant, USA
Robert E. Lee, CSA
W. T. Sherman, USA
John Bell Hood, CSA
Abraham Lincoln, USA
George B. McClellan, USA
Jubal Early, CSA
James Longstreet, CSA
John M. Schofield, USA
George H. Thomas, USA

Places/Ships

Wilderness Campaign
Atlanta Campaign
Petersburg/Richmond Campaign
Battle of Franklin Map
Fall of Nashville, Tennessee and Savannah, Georgia

1865

Motivational Question

What was the last astronomical discovery during the Civil War period?

Everyone knew the war was coming to its conclusion. The more willing peace factions were talking about negotiations, and several parties were endeavoring unofficially to get the process started in Richmond. Economically the North was sound. Now, many tiring of the war turned their thoughts to westward expansion and new international commercial markets. The South needed to rebuild and create a "new South." But first, the war would have to be resolved.

By the end of January, Robert E. Lee was named General-in-Chief of the Confederate Armies. Lee's appointment came too late in the war to have much bearing on the outcome. Little by little each Confederate stronghold weakened under the constant Federal pressure.

On February 17th the **minor planet, Clotho**, was discovered.

On the same day of the discovery of the minor planet Clotho, Charleston, South Carolina was evacuated and there was talk of Lee evacuating Richmond. A few weeks later Lincoln took his second oath of office as President of the United States as the war dragged on.

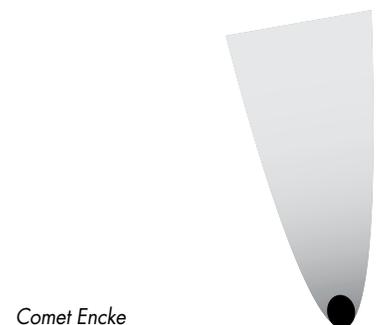
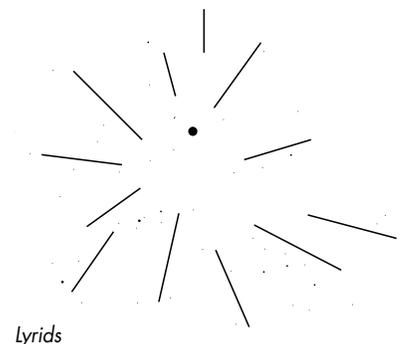
Ultimately on March 29, General Lee began his last campaign, The Appomattox Campaign. Lee started to move West in a vain attempt to make one last stand as a unified Southern army against the wrath of the Federal onslaught. The Confederate government evacuated Richmond on April 2. On Monday, April 3, the Federal troops occupied Richmond and Petersburg, Virginia. On Tuesday, April 4, Lincoln arrived in Richmond. He walked to the White House of the Confederacy and sat at Jefferson Davis' desk.

On Wednesday, April 5, Lee could not acquire any supplies as the Federal army had cut off the railroads. On Thursday, April 6 the final major confrontation of the Army of Northern Virginia took place at Saylor's Creek. The Confederates fought valiantly but to no avail as they were badly outnumbered and had no ammunition or resources. After hearing of the humiliating defeat, Lee asked "My God, has the army been dissolved?"

On Friday, April 7, Grant asked Lee to surrender. They decided to meet on Sunday, April 9 where the Army of Northern Virginia surrendered. In the weeks that followed, the surrender of each part of the Confederacy transpired. The war was finally over.

The early part of April saw many small astronomical occurrences — the most relevant of which were several **meteor showers of the Lyrids** between April 20-21. New discoveries were made of **the stars Lachesis, Atropos, Minerva, and Aurora**. Nevertheless, the most interesting sighting was the **Comet Encke** toward the end of April. This comet had a very short orbital period of about 3.5 years and was not strongly visible with the naked eye.

Even though the war was officially over, a new era was about to unfold: the period of Reconstruction in the South. To those who believed that comets were a sign of despair, this time it was true for the people in the South.





Suggested Visual Aids: 1865

Maps

Large wall or free standing map of the "Divided Nation, 1861-1865" or the United States of America with a plastic overlay outlining the Confederate States of America.

Photographs

People

Robert E. Lee, CSA

Abraham Lincoln, USA

Places/Ships

Fall of Richmond

The Appomattox Campaign

Battle of Saylor's Creek

Surrender of Lee



Activities

Activity Topic/Title	Integrated Discipline
1. Watercolors in the Night Sky	Astronomy & Art
2. The Comet: A Celestial Poem by Oliver Wendell Holmes, Sr.	Language Arts
3. The Century of the Comet: the Nineteenth Century	Science, History, Language Arts & Computer Technology
4. Solar Wind Diagram	Science & Art
5. The Great War Comet of 1861	Astronomy, Art, History & Computer Technology
6. The Great War Comet of 1862	Astronomy, Geography History & Computer Technology
7. The Year of the Aurora Borealis: August and December, 1862	Astronomy, History, Geography, Language Arts, Computer Technology
8. Asteroids, Meteors and Comets: What Are the Differences?	Astronomy & Art
9. Meteorites in the Classroom	Astronomy & Earth Science
10. What is a Zodiacal Light?	Astronomy

MATERIALS

- 9" x 12" watercolor paper
- watercolor paints and brushes
- small dishes for water
- newspaper

I. Watercolors in the Night Sky

Integrated Subjects

Astronomy and Art

Motivational Question

How would you depict the aurora borealis on paper?

Introduction to the Lesson

Ask the students the following questions:

- Who can describe an aurora borealis?
- What shapes does it make?
- What colors are in the aurora borealis?
- How are the shapes and colors formed?
- How would you interpret an aurora borealis on paper?

Process Skill Lesson

Pass out a set of supplies to each student. Have the students spread newspaper on the tables or desks. Ask the art teacher to review the procedure for using watercolors. Permit the students to freely create their watercolor interpretations. Dry thoroughly before matting.

Follow-up

Mat and hang the watercolor paintings. Now everyone may enjoy the "Watercolors in the Night Sky."

Note

*Prior to this lesson, show the students the 45-minute video *Aurora: Rivers of Light in the Sky*, if desired. This video is available from PBS Home Video, Catalog Mail Order Center, P. O. Box 751089, Charlotte, NC 28275-1089, phone: 1-800-645-4727.*

2. The Comet

A Celestial Poem by Oliver Wendell Holmes, Sr.

Subject

Language Arts

Process Skill Lesson

- Pass out copies of the poem *The Comet*.
- Have the students read it silently and then read it together aloud.
- Discuss each stanza.
- Ask the students to write their own poem using the information they gleaned from the STARLAB presentation and the other comet-based activities in this unit. The results can be very rewarding and surprising!

Follow-up

Ask the students to do an illustration of their poem.

Read some other celestial poems by Holmes.

Note

This activity would be wonderful to include in a student literary portfolio or anthology.

The Comet by Oliver Wendell Holmes, Sr.

Holmes had a great appreciation for astronomy since his childhood. When he was nine years old, he paid ten cents to view the planet Venus through a telescope. As a young poet, his interest in astronomy became profound. In 1832, at the age of twenty-three, he had a dream of the destruction of the Earth by means of a collision with a huge comet. From this visualization, he gained the inspiration to write the following poem:

MATERIALS

- copy of the poem: *The Comet*
- paper, pencils or pens

The Comet

by Oliver Wendell Holmes, Sr.

The Comet! He is on his way,
And singing as he flies;
The whizzing planets shrink before
The spectre of the skies;
Ah! well may regal orbs burn blue,
And satellites turn pale,
Ten million cubic miles of head,
Ten billion leagues of tail!

On, on by whistling spheres of light
He flashes and he flames;
He turns not to the left nor right,
He asks them not their names;
One spurn from his demoniac heel, —
Away, away they fly,
Where darkness might be bottled up
And sold for "Tyrian dye."

And what would happen to the land,
And how would look the sea,
If in the bearded devil's path
Our earth should chance to be?
Full hot and high the sea would boil,
Full red the forest gleam;
Methought I saw and heard it all
In a dyspeptic dream!

I saw a tutor take his tube
The Comet's course to spy;
I heard a scream, — the gathered rays
Had stewed the tutor's eye;
I saw a fort, — the soldiers all
Were armed with goggles green;
Pop cracked the guns! whiz flew the
balls!
Bang went the magazine!

I saw a poet dip a scroll
Each moment in a tub,
I read upon the warping back,
"The Dream of Beelzebub;"
He could not see his verses burn,
Although his brain was fried,
And ever and anon he bent
To wet them as they dried.

I saw the scalding pitch roll down
The crackling, sweating pines,
And streams of smoke, like water-spouts,
Burst through the rumbling mines;
I asked the fireman why they made
Such noise about the town;
They answered not, — but all the while
The brakes went up and down.

I saw a roasting pullet sit
Upon a baking egg;
I saw a cripple scorch his hand
Extinguishing his leg;
I saw nine geese upon the wing
Towards the frozen pole,
And every mother's gosling fell
Crisped to a crackling coal.

I saw the ox that browsed the grass
Writhe in the blistering rays,
The herbage in his shrinking jaws
Was all a fiery blaze;
I saw huge fishes, boiled to rags,
Bob through the bubbling brine;
And thoughts of supper crossed my soul;
I had been rash at mine.

Strange sights! strange sounds! O fear-
ful dream!
Its memory haunts me still,
The steaming sea, the crimson glare,
That wreathed each wooded hill;
Stranger! if through thy reeling brain
Such midnight visions sweep,
Spare, spare, oh, spare thine evening
meal,
And sweet shall be thy sleep!

Glossary of terms from the poem “The Comet”

In order of usage in the poem:

Spectre — ghost

Demoniac — influenced or produced by a demon

Tyrian dye — crimson or purple dye from the people of Ancient Tyre

Dyspeptic — a person having indigestion

Tutor — a private teacher

Magazine — a room where gun powder is stored

Beelzebub — The devil

Anon — soon, presently

Writhe — to twist into coils or folds

Herbage — green plants or vegetation

Pitch — black tar

Pullet — young chicken

Bob — a short, jerking motion

Brine — water saturated with salt

Wreathed — to contort or twist

**Other select poems with celestial content by
Oliver Wendell Holmes:**

The Secret of the Stars

The Star and the Waterlily

The Stars are rolling in the Sky

The Stars their early vigils keep

The Sun fades into the Skies

The Sun stepped down from his golden throne

The Flaneur: During the Transit of Venus

Sun and Shadow

Wind-Clouds and Stars-Drafts

MATERIALS

- computers with internet access
- excerpts from "The Comet-Crazy Century"

3. *The Century of the Comet: The Nineteenth Century*

Integrated Subjects

Astronomy, Social Studies, Language Arts & Computer Technology

Motivational Question

How much is known about the comets sighted in the nineteenth century?

Process Skill Lesson

- Read the excerpts from "The Comet-Crazy Century." Take special note of the comets visible during the years, 1861, 1862, 1863, 1864, and 1865.
- Then access the following website to obtain as much data as possible on five other comets not visible during the Civil War years:

<http://library.caltech.edu/collections/astrophysics.htm>

http://encke.jpl.nasa.gov/bright_comet.html

http://www.oarval.org/section3_16.htm

- Write an essay on the findings using word processing.

Follow-up (see Suggested Resources)

Make a Comet in the Classroom by Dennis Schatz

A Viewgraph Comet by Julieta Fierro

Make a Comet by Grant Nicholson

Excerpts from "The Comet-Crazy Century"

Because of its many spectacular apparitions (about thirteen naked eyed comets and a total of three hundred comets sighted all together), the nineteenth century should rightfully be known as "The Comet Century." These comets passed over the Earth during a pivotal period in Western civilization, one that experienced the gigantic upheavals of the Industrial Revolution, Nationalism, Positivism, the theories of Freud and Marx — in short, nothing less than the birth of the modern age. In 1882, the first generally-acknowledged, good scientific photograph of a comet was taken, changing the course of cometology forever.

While the people of this century were basically motivated by an intense romantic longing, scientists viewed cometology using a more objective basis. They studied comets as part of celestial mechanics, resulting in a more thorough understanding of the physical nature of comets. Around the turn of the century, the distinct natures of meteors, meteorites, and asteroids were more firmly defined, but it was not until mid century that meteors and comets were clearly distinguished, and the axiom "If it moves and is in the heavens, call it a comet," no longer applied.

Throughout the century, as the understanding of optics grew more sophisticated, larger refracting telescopes were constructed, which substantially aided celestial sleuthing . . . [73]

During the mid-nineteenth century, several other memorable comets careened across the sky, two of which were commonly associated by Americans with the Civil War. In 1861, Comet Tebbutt appeared, first spotted by the amateur astronomer J. Tebbutt in

Windsor, Australia, on May 13. According to contemporary descriptions, while this naked-eye apparition did not surpass Donati's Comet in beauty, it had other unique attractions. For example, it was decidedly more brilliant and had a yellowish-red head, a complex nucleus, eleven surrounding envelopes, and an extremely long tail estimated at between 90 and 120 degrees. It was so bright between June 29 and July 1, that it cast shadows at night! Tebbutt's Comet was also visible during daylight and is thought by some to have been the brightest comet of the century . . . [97]

The comet's appearance caused consternation among the general public and probably stimulated yet another generation of artist to employ topical comet imagery. For example, Gustave Moreau's *The Procession of the Kings of 1861* (in the Musée Gustave Moreau, Paris) upholds the tradition of substituting a comet for the Star of Bethlehem, while an illustration for *Vanity Fair* magazine personifies General Winfield Scott, a warmonger, as "The Great War Comet of 1861." A caricatured portrait of the General functions as the head of the comet; the General's Victorian whiskers and hair form the coma; and an army of rattling, sharply pointed bayonets comprise the comet's tail.

Tebbutt's Comet was the first comet to receive attention from a professional photographer, the Englishman Warren de la Rue, one of the great pioneers of astronomical photography. After seeing daguerreotypes at the Exhibition of 1851, he photographed the sun and eclipses. He also tried, without success, to record a comet apparition. De la Rue did manage, however, to preserve a record of Tebbutt's Comet for posterity in the drawings that he made with the aid of a telescope.

Another "Civil War comet" was the Great Comet of 1862, the periodic Comet Swift-Tuttle, discovered by the American Lewis Swift. Although it failed to equal Tebbutt's Comet in either magnitude or brilliance, it was nevertheless striking and notable for the peculiar jets of light, frequently altering in their forms that spurted from its nucleus. Some superstitious comet watchers interpreted these celestial fireworks as a herald of the battles of Shiloh and Williamsburg . . . [100]

On April 17, 1874, a bright comet was sighted from Marseilles by J. E. Coggia. It had at least three nuclei points and at one time exhibited a star-shaped nucleus. Bright jets spurted out from its head, and a black line was seen bisecting its tail. Astronomical drawings of the time attest that its head was surrounded by many envelopes.

People never seem to tire of comets, and their appetites must be periodically assuaged by feasting on new apparitions. Toward the end of "The Comet Century," when photography was in use and the charm of Realism had somewhat waned, many artists, intoxicated and actual apparitions, once again realized the potent, emotional symbolism of comets. One case in point is Jules Verne's *Off on a Comet*, published in 1878, a year of three comets. A second is found in an illustration for another of Verne's books, *From the Sun to the Moon*. [102]

MATERIALS

- solar wind worksheet
- colored markers or pencils

4. Solar Wind Diagram

Integrated Subjects

Science and Art

Motivational Questions

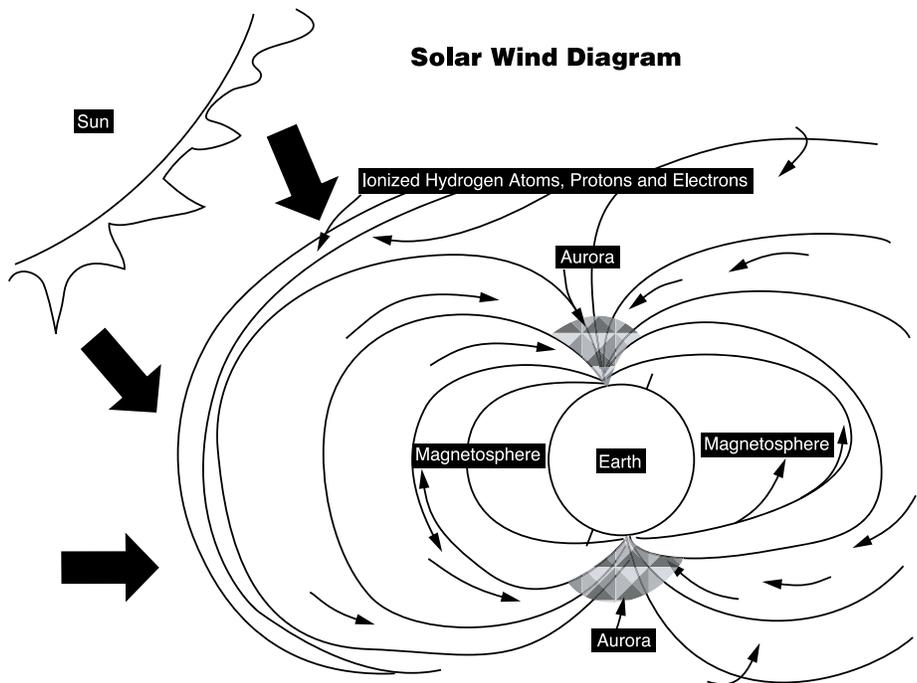
What is solar wind? What does solar wind create?

Process Skill Lesson

- Pass out the solar wind worksheets.
- Instruct the students to read the introductory statement and answer the questions.
- After a brief discussion about solar wind, ask the students to complete the Solar Wind Diagram.

Follow-up

Solar Wind Demonstration



Name _____

Date _____

The Solar Wind Worksheet

Solar wind consists of ionized hydrogen atoms, protons and electrons swiftly blowing from the Sun into space. When this solar wind gusts against the giant magnetic field or magnetosphere surrounding the Earth, some of these highly charged particles pierce the magnetic lines of force consequently building a natural electric generator. At this point, a current from this "generator" flows down magnetic field lines and gathers high in the atmosphere at both ends of the north and south poles. When this occurs, oxygen, nitrogen and other gases become turbulent and give off a glow of various colors and shapes. This light is commonly called an aurora. Living in the Northern Hemisphere we see an aurora borealis or "northern lights." This event can be spectacular to observe.

1. What material is formed to create a solar wind?
2. Why is this occurrence called a "solar wind?"
3. Define magnetosphere.
4. How does the solar wind create a "natural electric generator?"
5. Where does the magnetic field lines gather and what occurs?
6. Give another name for the "aurora borealis."

MATERIALS

- computers with internet access
- paper and pencils for note taking
- drawing paper and pencils for sketching

5. The Great Comet of 1861

Integrated Subjects

Astronomy, Art, History & Computer Technology

Motivational Question

Why was the comet of 1861 considered a "great" apparition?

Process Skill Lesson

- Distribute the worksheets on the Comet Tebbutt of 1861.
- Have students access the following websites:

The Comet Observation Homepage:

http://encke.jpl.nasa.gov/bright_comet.html#pre1900

<http://comets.amsmeteors.org/comets/lcomets/1861j1.html>

- Have students take notes from the data, then answer the data questionnaire sheet.
- From the notes taken by the students, ask them to draw their interpretation of The Great Comet of 1861.

Follow-up (see Suggested Resources for the Internet)

Make a Comet in the Classroom by Dennis Schatz.

A Viewgraph Comet by Julieta Fierro.

Make a Comet by Grant Nicholson.

The Great Comet of 1861 Worksheet

The Great Comet of 1861

1. Who discovered the Great Comet of 1861?
2. Name the date of the discovery.
3. What name was given to the comet?
4. The comet was observed passing closest to the Earth on what date?
5. How did astronomers describe this observation?
6. What was the comet's greatest magnitude? How many degrees was its tail?
7. In July, between the dates of the 18th and 24th, two noted astronomers Schonfeld and Peters, noticed fading differences in the comet. Schonfeld said the nucleus appeared a little defuse on the 18th, while Peters noted on the 24th, "The nucleus now appears much less stellar than before, rather as a blurred surface of 8" in diameter, though this measure is little unreliable." He added that the outline of the envelope was no longer visible, though the moon was nearly full. At the same time as this observation, what major event was taking place in the State of Virginia?

MATERIALS

- American history textbook
- blank map of the United States of America
- copies of the excerpts from "The Comet-Crazy Century"
- copies of the data from the Royal Greenwich Observatory on Comet Swift-Tuttle and the Perseid Meteors (following pages)
109P/Swift-Tuttle data sheet (from the internet)

6. The Great Comet of 1862

Integrated Subjects

Astronomy, History, Geography and Computer Technology

Motivational Question

What was the Great Comet of 1862?

Process Skill Lesson

- Ask the students to read the data from the Royal Greenwich Observatory (see next several pages) and access the following website for detailed information on the Comet Swift-Tuttle:

<http://www.comets.amsmeteors.org/comets/pcomets/109p.html>

- Then have them answer the questions on the worksheet.
- On the blank map of the United States of America, ask the students to locate the Civil War battles which took place in 1862 prior to the sighting of the Comet Swift-Tuttle and locate the one major battle in September 1862.

Information Leaflet No. 56 (rev) from the Royal Greenwich Observatory

“Comet Swift-Tuttle.”

Science and Engineering Research Council

Periodic Comet Swift-Tuttle (1992t)

Periodic comet Swift-Tuttle was last seen in 1862. Its orbit was then calculated to have a period of about 120 years. It was predicted to return in 1982 but was not observed. Because of this, there was speculation that the comet had disintegrated. This theory was supported by its association with the Perseid meteor stream (see pamphlet *Meteors and Meteorites*). Meteor streams like this are believed to be formed of small parts that have become detached from the main body of the comet during one of its close approaches to the Sun. These small pieces become scattered along the length of the comet's orbit around the Sun. If the Earth passes through the resultant stream of particles then we see them as meteors, or 'shooting stars,' when they burn up in the atmosphere.

Comet Swift-Tuttle was rediscovered in September 1992 almost 10 years away from its expected position. The reason for this large discrepancy is not due to inaccuracies in the old observations or in the calculations based on them. When a comet passes near to the Sun some of its matter is evaporated by the Sun's radiation. This evaporation does not necessarily happen symmetrically but can act rather like a variable rocket motor attached to the comet causing non-symmetrical forces which distort its orbit in an unpredictable way.

From revised calculations made using the observations made in 1992 and those of 1862, it has been shown that the comet is identical with Comet Kegler observed in 1737. Initially it proved impossible to obtain a definitive orbit which satisfied all the observations, even including terms to allow for the effects of evaporation.

Using the best orbit then available, the comet's position at any time in the future can be predicted. The best estimate for the time of closest passage to the Sun during its next approach is 2126 July 11. An error of +15 days in this date would mean that the comet could collide with Earth on 2126 August 14.

The chance of collision would be very small even though the Earth does pass through the orbit of the comet. The comet will be moving at a speed of 60 kilometres per second, relative to the Earth. This means that there is only a period of a few minutes during which a collision is possible. The comet will have to lie in this very small time interval in its orbit for a collision to occur.

The latest observations have allowed a better orbit for the comet to be determined and it is now clear that the comet will not hit the Earth. The revised orbit has allowed the identification of Swift-Tuttle with observations going back 2000 years.

Although we are confident that the comet will pass by the Earth, it will still be prudent to attempt to follow Swift-Tuttle for as long as possible after the present perihelion passage so that an accurate orbit determination, uncontaminated by nongravitational effects, can be made from mid-1993 (when the distance to the comet will be 3 AU) to, say, 1998 (when its distance will be 15 AU and it will have an apparent magnitude of 26).

The effects of a collision of a comet like this, with a diameter of about 10 kilometres, with the Earth would be devastating. Such a collision is thought by many to have been the cause of the demise of the dinosaurs. The 'explosion' resulting from the collision would be about 1000 million times greater than the bomb that destroyed Hiroshima. A huge cloud of dust, thrown in to the upper atmosphere, would envelope the globe for many years and this would cause widespread changes in climate, even to producing an ice age. The effects on civilization can only be guessed at but would be very severe.

The chances of such a collision are very difficult to estimate. If we take the known velocity of the comet relative to the Earth, then we can work out that the comet will only collide with the Earth if it is within a three and a half minute time-slot in its orbit. This means, for instance, that an error of only one hour in the timing of the comet will result in it missing the Earth by about 100 thousand kilometres.

If we compare that accuracy with the error of 10 years in this predicted return we can see how difficult such predictions are!

The comet has now moved into the southern sky and is not visible from the UK.

Sources

Produced by the Information Services Department of the Royal Greenwich Observatory.

Reprinted from http://www.oarval.org/section3_16.htm

Short Special Information Leaflet No. 4 from the Royal Greenwich Observatory

“The Perseid Meteors”

Particle Physics and Astronomy Research Council

The Perseids

One of the most prolific meteor showers is the Perseids. The radiant is in the constellation Perseus, and meteors from this shower can be seen over a period of about 3 weeks centered on August 12. In good years up to 70 meteors an hour can be seen near the peak.

This meteor stream is associated with Comet Swift-Tuttle, which passed close by the Sun in 1992. As the meteors in the stream are thought to be dust particles released from the comet, it is thought likely that there is a dense stream of such particles in the path of the comet and located close to it.

The last time (1993) that the Earth passed through the comet's orbit just after the comet had been close to the Sun, there was a radical increase in the number of meteors seen, rising to about 300 an hour. It is thus likely that when the Earth passes through the comet's path on August 12, there may be a very high peak in the number of meteors seen.

The peak could well be only an hour long, and the exact time of the Earth passing through the maximum is only poorly known, and so it will be worth keeping a lookout from about midnight onwards, always assuming that the skies are clear!

Produced by the Information Services Department of the Royal Greenwich Observatory.

ARVAL's Note

The Perseids have become the most exciting meteor shower in recent years, producing hourly rates of around 300 in 1993, 220 in 1994, 160 in 1995, and around 140 in 1996, at the shower's primary maximum, which this year is expected to fall around 06h UT on August 12.

The return of the Perseids' parent comet Swift-Tuttle in late 1992 was almost certainly responsible for producing this recent increase.

Whether the Perseid peak will continue the decreasing trend in the primary maximum's rates remains to be seen, but conditions are reasonable for trying to cover the 1997 event, as the waxing gibbous Moon will set just before midnight for most northern hemisphere observers on August 11, and by then the shower radiant will be at a good elevation.

Information from the 1997 Meteor Shower Calendar of the International Meteor Organization (IMO)

Comet Swift-Tuttle was discovered independently by Lewis Swift and Horace Tuttle in 1862. The comet has an orbital inclination of 113° and a period of about 128

years. It was associated with the Perseids meteor shower by Giovanni Schiaparelli in 1862. (1)

The Perseids is one of the most consistent and active showers, and has a proven double peak, with a short outburst a number of hours prior to the main maximum. (2)

The radiant of the Perseids is at R.A. 03h 04m, +57° (3)

Also called "The Tears of St. Lawrence," whose feast day, August 10, used to coincide with the shower's maximum in the 18th and 19th centuries. Precession gradually moved the Perseids' maximum to August 11 in the 1890s, and now more often to August 12.

Short Perseids outbursts have occurred from 1991 to 1996. (3)

Sources

(1) *The Facts on File Dictionary of Astronomy*. Edited by Valerie Illingworth.

(2) *Observer's Handbook of 1997*. The Royal Astronomical Society of Canada.

(3) *Astronomical Calendar 1997*. The Department of Physics, Furman University in cooperation with the Astronomical League.

Reprinted from <http://www.oarval.org/perseids.htm>

The Great Comet of 1862 Worksheet

The Great Comet of 1862

1. What is the name of the Great Comet of 1862?
2. In what year in the 20th century was it supposed to reappear?
3. Did it reappear as predicted? If not, what was the possible reason?
4. In what year did it finally appear? What was the reason for its late arrival?
5. Within the data "The Comet-Crazy Century," what two major Civil War battles were supposed to be "heralded" in by this comet?
 - 1.
 - 2.
6. What battle actually took place in September nearer the time of the Comet Swift-Tuttle sighting?
7. Who were two opposing generals in the Battle of Sharpsburg/Antietam?

Federal:

Confederate:

MATERIALS

- computer with internet access
- paper, pencils, pens
- blank map of the United States
- American history textbook
- copies of the *Eyewitness Accounts of Civil War Officers* including the following excerpts:

Freeman, Douglas Southall. *Lee's Lieutenants*. V. 2

Hotchkiss, Jedediah. *Make Me a Map of the Valley*

Stiles, Robert. *Four years under Marse Robert*

Trulock, Alice Rains. *In the Hands of Providence Joshua L. Chamberlain and the American Civil War*

7. The Year of the Aurora Borealis, 1862

Integrated Subjects

Astronomy, History, Geography Language Arts & Computer Technology

Motivational Question

When were two auroras borealis seen in the Mid-Atlantic states during 1862?

Process Skill Lesson

Ask students to access the following websites:

1. This site has general data on the aurora borealis or northern lights.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part01.htm>

2. This site provides folklore in reference to the Aurora.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part02.htm>

3. This site provides data on the causes of the phenomenon.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part03.htm>

In order to acquire more in depth knowledge access the next websites:

4. This concerns the Earth's magnetic field.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part04.htm>

5. This pertains to the Aurora outbreak.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part05.htm>

6. This is about the quantum leap!

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part06.htm>

7. This site is about the northern lights oval.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part08.htm>

8. This site pertains to the northern lights and climate.

<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part09.htm>

- After the students have completed viewing the websites, ask them to write an essay on their findings.
- Now ask them to read the *Eyewitness Accounts of Civil War Officers* handout.
- Pass out the blank maps of the United States. Have the students locate the battlefields where the summer aurora borealis and the winter aurora borealis occurred.
- Ask them to write a comparative essay on the December aurora as observed by Jedediah Hotchkiss, Robert Stiles and Joshua Lawrence Chamberlain from primary documentation (see *Eyewitness Accounts of Civil War Officers*).

The Year of the Aurora Borealis Worksheet

August and December, 1862

1. Access the following website and follow directions to complete this in depth activity:
 - a. This site has general data on the aurora borealis or northern lights.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part01.htm>
 - b. This site provides folklore in reference to the Aurora.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part02.htm>
 - c. This site provides data on the causes of the phenomenon.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part03.htm>
2. In order to acquire more in depth knowledge access the next websites:
 - a. This concerns the Earth's magnetic field.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part04.htm>
 - b. This pertains to the Aurora outbreak.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part05.htm>
 - c. This is about the quantum leap!
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part06.htm>
 - d. This site is about the northern lights oval.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part08.htm>
 - e. This site pertains to the northern lights and climate.
<http://www.imv.uit.no/english/science/publicat/waynorth/wn1/part09.htm>
3. After completing the websites, write a lab report on your findings on separate sheets of paper.
4. Now read the Eyewitness Accounts of Civil War Officers handout.
5. Obtain a blank map of the United States and locate the battlefields where the summer and winter aurora borealis occurred.
6. Write a brief account of each battle, including the opposing generals and the outcome of the specific battle.
7. Write a comparative essay on the December aurora as observed by Jedediah Hotchkiss, Robert Stiles and Joshua Lawrence Chamberlain using their data as a primary resource.

MATERIALS

- pencils
- pens or color markers
- drawing paper
- copy of the Abridged Astronomical Glossary

8. Asteroids, Meteor and Comets

What Are the Differences?

Subject

Astronomy & Art

Motivational Question

What are the differences between an asteroid, a meteor and a comet?

Process Skill Lesson

- Give each student a copy of the Abridged Astronomical Glossary and the following data worksheet.
- Read and discuss the definition of an asteroid, meteor and comet.
- Ask the students to draw their interpretation of each celestial phenomenon.

Asteroids, Meteors and Comets Worksheet

What are the differences?

Asteroids

- Most asteroids are located in a belt between Mars and Jupiter. There are thousands of these asteroids in this area however, they are far apart.
 - The typical asteroid is irregular in shape and only a few miles across, although there are a few which are several miles across. The total mass of all of these asteroids combined would be smaller than our moon.
 - Most asteroids are made up of rocky material left over from the time our Solar System was formed. Asteroids are not able to form a large planet because of the constant movement created by Jupiter's tidal forces.
 - Periodically chunks of rock and iron collide with the Earth and produce meteors as they burn up in our atmosphere or meteorites when they strike the Earth's surface.
1. Where are most asteroids located in space?
 2. Describe a typical asteroid.
 3. Why are asteroids unable to form into large planets?
 4. What is produced when chunks of rock and iron collide with the Earth?

Meteors

- Meteors are the luminous trails of heated air produced behind a meteoroid. Though this has nothing to do with the stars, frequently when they are observed people refer to them as "shooting" or "falling stars."
 - Meteors are not rare. They can be observed on nearly any clear moonless night at a location where the sky is relatively dark. The streak of the meteor will last only a second and fade from view immediately.
1. What is a meteor?
 2. Is it factual to call a meteor a "falling" or "shooting star?" Why?
 3. State the conditions which are needed to view a meteor.
 4. How long does a meteor streak remain visible in the sky?

Comets

- Comets are a mass of frozen gases revolving around the Sun, generally in a highly unusual orbit. At any given time a comet may pass through the inner Solar System. It is rare when they can be seen with the naked eye. The brighter the comet with the longest tail traveling closely to the Sun will provide the best visibility to the non-telescope viewers.
 - Although it can be seen in any part of the sky, it is best seen in the eastern sky before sunrise and the western sky after sunset. Unlike meteors which streak across the sky, the comet hangs among the stars. Its position changes gradually night after night until it disappears.
1. Where are comets located?
 2. Describe what a comet must possess to be visible to the naked-eye observer.
 3. In what part of the sky can a comet be seen?
 4. When is the best time to view a comet?

MATERIALS

- dust collected on microscope slides for one week
- microscope
- paper and pencils for notes

9. Meteorites in the Classroom

Integrated Subjects

Astronomy and Earth Science

Motivational Question

Where are meteorites located in the classroom?

Process Skill Lesson

- Have students place several microscope slides on a clean paper towel and leave it undisturbed for at least a week.
- After a week, have the students carefully view the dust on the glass slide. Ask them to write a short lab report on their findings.
- The students should report on locating several little ball-shaped objects.
- Explain to the students that these are meteorites collected daily from the atmosphere and that we are constantly being bombarded with these tiny meteorites from space.



10. What is a Zodiacal Light?

Subject

Astronomy

Motivational Question

How does a zodiacal light appear?

Process Skill Lesson

- Read the data on the zodiacal light on the worksheet.
- Complete the associated questions.

MATERIALS

- pencil or pen

What is a Zodiacal Light Worksheet

Zodiacal light may be seen as a faint cone of light rising from the horizon after sunset or before sunrise. It extends away from the Sun and is generally observable for a fairly short period only after the Sun has disappeared or before it has risen. In 1683, G. D. Cassini correctly stated that the light was caused by sunlight reflected by interplanetary dust. On a clear, moonless night under ideal conditions, it contributes about one-third of the total sky light, and may be brighter than the average Milky Way region. Its brightness is due to particles scattered in the Solar System along and near its main plane. The diameter of the particles are of the order of 0.1 to 0.2 micron. (One micron is equal to one-millionth of a meter.) Since the zodiacal light extends along the ecliptic, it is best seen when the ecliptic is almost nearly vertical to the horizon, usually in February to March and again in September to October.

1. What shape does the zodiacal light usually take?
2. What time of day is best for seeing this light?
3. Who discovered and documented the cause of zodiacal light? In what year?
4. If conditions are right on a clear, moonless night what may occur?
5. Which is brighter: the Milky Way or zodiacal light?
6. One micron is equal to:
7. Since the zodiacal light extends along the ecliptic, when is the best time to view it?

Suggested Resources for Follow-up Activities

From the Library

History/Language Arts — Write a book report:

Title: Passing of the Armies

Author: Joshua Lawrence Chamberlain

Title: Personal Memoirs of U. S. Grant

Author: U. S. Grant

Title: Make Me a Map of the Valley

Author: Jedediah Hotchkiss

Title: General Lee

Author: Fitzhugh Lee

Title: Fours Years Under Marse Robert

Author: Robert Stiles

Title: Jeb Stuart Speaks

Author: Bernice-Marie Yates

From the Internet

Astronomy

Solar Wind Demonstration by Mary Urquhart at the University of Colorado, Boulder, CO

http://lyra.colorado.edu/sbo/mary/comet/solar_wind_demo.html

Making a Comet in the Classroom by Dennis Schatz of the Pacific Science Center, Seattle, WA

<http://whyfiles.org/011comets/crecipe.html>

Make a Comet by Grant Nicholson of Questacon — The National Science and Technology Centre, Canberra Australia

http://www.questacon.edu.au:80/html/make_a_comet.html

Viewgraph Comet by Julieta Fierro at Universidad Nacional Autónoma de México

<http://aspsky.org/education/tnl/36/activity.html>

Resources

Chartrand, Mark R. *National Audubon Society Field Guide to the Night Sky*. Alfred A. Knopf: New York, 1997.

Griess, Thomas E. ed. *The West Point Military History Series Atlas for the American Civil War*. Avery Pub.: Wayne, New Jersey, 1986.

Hotchkiss, Jedediah. *Make Me a Map of the Valley*. Southern Methodist University, Dallas, Texas: 1973.

Kerrod, Robin. *The Star Guide*. MacMillan: New York, 1993.

Long, E. B. *Civil War Day by Day: An Almanac 1861-1865*. Doubleday: New York, 1971.

Mitchell, Adele. *The Letters of General J. E. B. Stuart*. Stuart-Mosby Historical Society: Harrisburg, Pennsylvania, 1990.

Parkes, Mike and Mark Dykstra. *Starry Night Backyard*. Space.com Incorporated: 1993-2000.

Scudder, Horace E. *The Complete Poetical Works of Oliver Wendell Holmes*. Houghton Mifflin Co.: Boston, 1908.

Silliman, B., Silliman B. Jr. and Dana, James D. *American Journal of Science and Arts, 1861-1868*. Yale University: New Haven, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868.

Stiles, Robert. *Four Years under Marse Robert*. R. Bemis Pub. Ltd.: Marietta, Georgia, 1903.

Trulock, Alice Rains. *In the Hands of Providence Joshua L. Chamberlain and the American Civil War*. University of North Carolina Press: Chapel Hill, 1992.

Ward, Geoffrey C., Ric Burns and Ken Burns. *The Civil War: An Illustrated History*. Alfred A. Knopf: New York, 1990.

Suggested Visual Aids Resources

Local and State Libraries

The National Civil War Museum, Reservoir Road, Harrisburg, PA. Phone: 717-260-1861

Civil War Museum and Library, Pine & 17th Street, Philadelphia, PA. Phone: 215-735-8196

National Park Service. For specific battlefield sites visit their Website: <http://www.nps.com>

Library of Congress, Washington, DC 20540-4730. Phone 202-7007-5000

National Archives, 8601 Adelphi Road, College Park, MD 20740-6001. Phone: 301-713-6625

Abridged Astronomical Glossary

Asteroid. A small, rocky chunk of matter orbiting the Sun.

Asteroid Belt. A strip or band located between Jupiter and Mars in which only asteroids orbit.

Aurora Borealis. A luminous phenomenon that consists of streamers or arches of light in the sky at night. It is produced by a solar wind that blows against the magnetosphere or giant magnetic field surrounding the Earth.

Comet. A huge lump of ice and dust normally frozen solid which appear only when they travel into the inner solar system.

Cometology. The study of comets.

Envelope. A distinct vaporous mass surrounding the nucleus of a comet on the side toward the sun and appearing like a bow.

Magnetosphere. The giant magnetic field that surrounds the Earth.

Magnitude. The brightness of a star, comet, or other object in the sky.

Meteor. The luminous trail of heated air produced by a meteoroid's passage through the Earth's atmosphere.

Meteorite. A meteoroid that reaches the surface of the Earth or another planet or moon.

Meteoroid. A rock in space on a collision course with the Earth; sources of meteoroids include comets and colliding asteroids.

Meteor Shower. An event caused by the Earth's passage through the orbit of a comet, where it collides with an increased number of tiny meteoroids; it happens at the same point in the Earth's orbit, therefore on the same date each year.

Minor Planet. An asteroid.

Moon Phases. The gradual changing shape from day to day of the moon observed on Earth.

Radiant. The point in the sky from which a meteor shower seems to radiate.

Star. One of many points of light in the night sky that maintains a fairly constant position with respect to its neighbors. It is a massive gaseous sphere, heated by gravitational compression until it radiates visible light. Stars generate energy by thermonuclear fusion in their core. The Sun is the closest star to the Earth.

Zodiacal Light. A nebulous light seen in the west after twilight and in the east before dawn.

